THE MODEL ENGINEER

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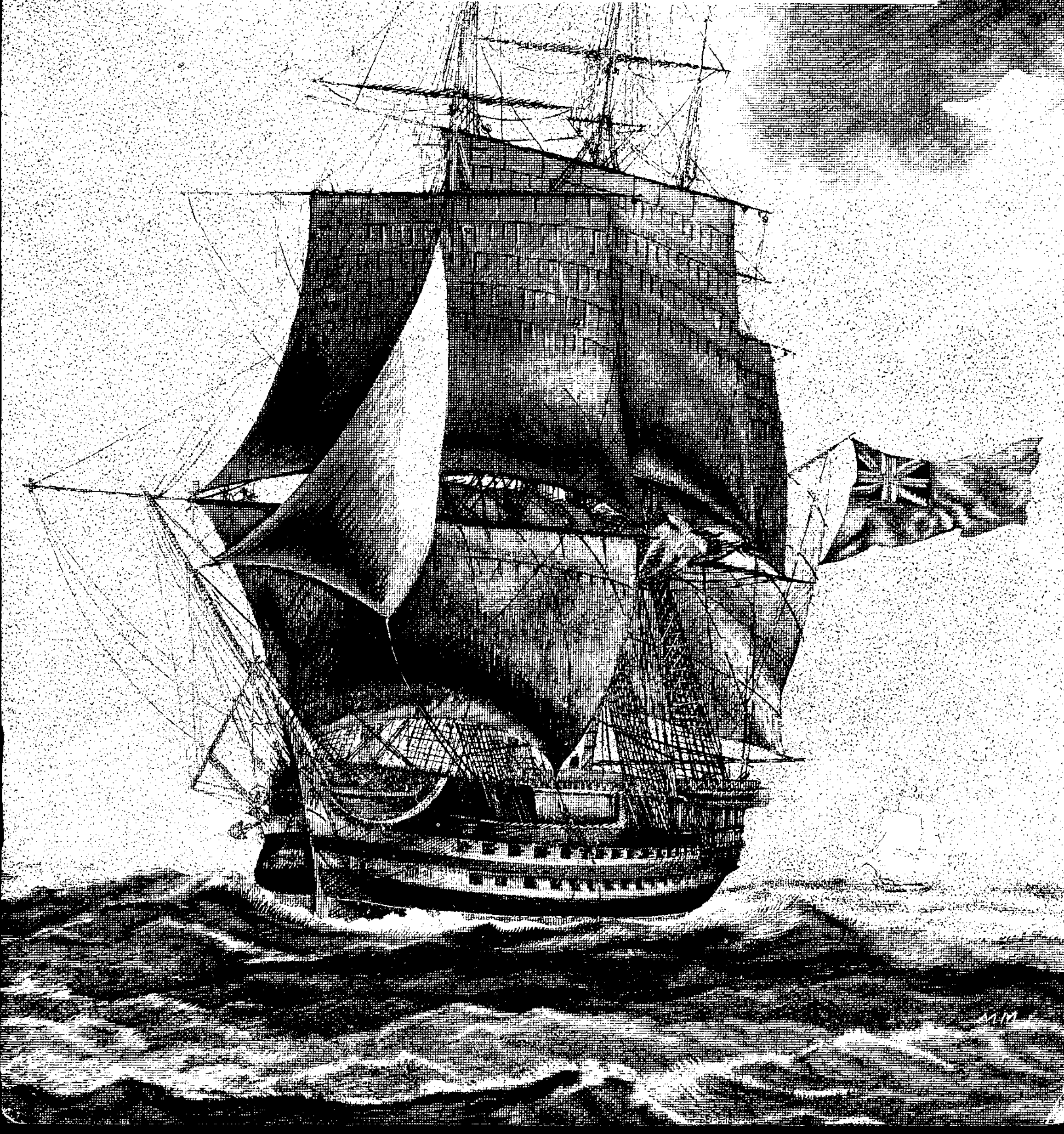

THE
MODEL ENGINEER
Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2

SMOKE RINGS

Our Cover Picture

THIS week's illustration is drawn from a painting by the marine artist, Frederic Roux, of a British 74-gun ship. These ships formed the backbone of the Fleet in Nelson's time, corresponding to the heavy cruiser of the present day. A well-made model of one of these ships is a beautiful possession, and is well within the capacity of the more experienced modeller. We hope soon to include in our pages some photographs and a description of such a model, with a reproduction of the contemporary drawings.

The "M.E." Exhibition

SOME of my readers are anxious to know the date of the 1947 MODEL ENGINEER Exhibition, so that they may plan their holidays and travelling arrangements accordingly. It will be held from August 20th to the 30th, both days inclusive, and will take place in the New Royal Horticultural Hall, the same building as last year. Having admirably served its purpose as a "get together" team after the long interval between exhibitions, the organising partnership between the S.M. and E.E., the S.M.A.E., and ourselves, has now been dissolved by mutual agreement, and the sole planning and control of the Exhibition reverts to THE MODEL ENGINEER as in pre-war days. We very much appreciated the friendly and effective collaboration of the two leading societies in making the 1946 exhibition such an outstanding success, a collaboration which did much to stimulate public recognition and appreciation of the valuable work which these two bodies are doing on behalf of their members, and model enthusiasts in general. We hope this aspect of club life may long be represented at future shows, in conjunction with the National demonstration of all that is best in model engineering, a function which our exhibition is designed specially to fulfil. For our 1947 show plans are being matured to ensure a most attractive display in all respects, not only in regard to the general interest and convenience of our visitors, but in relation to the most effective presentation of the exhibits. The usual competition sections will be an important feature, with the Championship Cups and a generous list of prizes on offer. Entry forms and full particulars will be available shortly, and will be announced in due course.

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Calling Mr. K. Raczak

THE medal awarded to this competitor in our 1946 Exhibition has been returned by the Post Office, owing to his change of address. It will be re-forwarded if he will kindly give us fresh instructions.

An Aldershot Exhibition

AN exhibition of models is to be held under the auspices of the Aldershot Society, on Saturday, April 5th, at the West End Schools, Queen's Road, Aldershot, from 2.30 p.m. to 7 p.m. A cordial welcome is extended to members of other societies and visitors generally who are able to come along. A good show is in preparation.

The Late Henry Greenly

MODEL engineering has suffered another great loss through the death of Mr. Henry Greenly, who passed away, at the age of seventy, at his home at Hounslow, on March 4th. He joined the Editorial Staff of THE MODEL ENGINEER in 1901 and for five years contributed many articles and designs of much practical interest to model engineers. Since 1906 he has been engaged as consultant to model engineering and technical commercial firms, and has become widely known for his books on model making and his extensive service in the supply of blueprints. He leaves a widow and two sons and a daughter, who are carrying on the business of Greenly's Models Ltd. We hope to publish a portrait and a fuller memoir in a later issue.

Ships and Men

TO tell the story of the evolution of the ship from the prehistoric days of the dug-out-canoe, to the marvels of the modern giantess *Queen Elizabeth*, is surely an ambitious undertaking, yet it is most adroitly and entertainingly achieved by W. J. Bassett-Lowke and George Holland in their jointly written book "Ships and Men," lately published by George G. Harrap and Co. Ltd., at 15s. There are, in fact, two sides to the story, one relating to the humanitarian and commercial needs of the peoples of the world arising from the effects of the voyages of discovery and of political and social developments, and the other detailing the ingenuity and skill of shipbuilders of all ages in enabling these human needs to be satisfied by providing adequate means of river and ocean transport. Both sides of the romance of sail and steam in navigation are admirably dovetailed together by the authors, and the reader is enabled pleasantly to appreciate why various types of craft were called into being and in what manner their technical details were evolved and improved. Thus we are told about the early ships of the Egyptians, Greeks and Romans, so artistic in appearance and so effective in their employment of both oar and sail, and the later influence on ship design of European trading, and of overseas discovery by the adventures of Italian, Spanish, and Portuguese merchant captains in search of new markets and new worlds to conquer. Ships grew in size and in sail spread, and, as we know, sail in time gave way to steam, as steam is now giving place to the oil engine. But during these centuries of progress other countries made their own important contributions to the navigation of the seas and the Norwegians, the Dutch and the Americans all figure appropriately in this story. No history of shipbuilding would, however, be complete without fully setting out the development of the British Mercantile Marine, from the days of the *Golden Hind* and the *Mayflower* to the magnificent liners of the Cunard, P. & O., Royal Mail, and other front-rank shipping companies, remembering on the way the glorious era of the *Cutty Sark* and her sister clipper beauties, with their marvellous passages under sail to Australia and the Far East. It is not without good reason that the "red duster" is held in high regard in every seaport in the world as the mark of a fine ship and fine seamen. All this story is admirably told and profusely illustrated by photographs and drawings of both ships and models. It is obvious that much patient research has been entailed in discovering and obtaining photographs of most interesting models in the leading nautical museums of both this country and the Continent. There is a wealth of material here to delight the eyes of the ship modeller in search of authentic prototype detail in any period. A passing thought on the changes brought about by time is provoked by a statement in the chapter on the early days of steam propulsion. The authors record that the invention of the steam railway "spelled the doom of road transport." A natural enough thought at the time of the remarkable performance of the new-fangled "Rocket," but who would say today that road transport in its modern form is not gnawing at the vitals of the railway? My congratulations to my friend Bassett-Lowke and his co-author George Holland, on a really well-planned volume, which I found most entertaining because of the fascination of its subject and the skill with which the story is told in both word and picture. It is handsomely produced, and is sure of an appreciative reception by ship lovers of all ages.

A Club for Preston

MODEL engineers in the Preston district who would like to get together for the purpose of forming a Club are invited to get into touch with Mr. W. Lamb, Loxham House, Fishwick. He very kindly offers the use of his workshop for informal meetings to enable the organisation to be arranged.

Ulster Show Plans

I HEAR that the preparations for the model exhibition in Belfast, to be held at the end of April, are making good progress. All the available trade space has been booked, but the Ulster Society would still be glad to have offers of good commercial models to add to the general attractions of the show. The committee intend that "the display shall make a lasting impression on all who are able to visit it." That is the right spirit, and model engineering in Northern Ireland should get a real stimulus. The Hon. Secretary is Mr. E. C. Munday, 10, Royal Avenue, Belfast.

Another Yorkshire Society

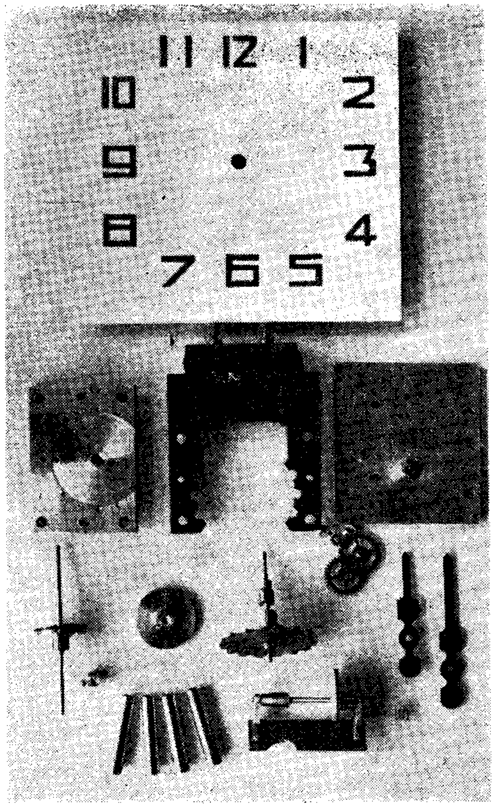
THE latest club to be formed in Yorkshire is for Otley and district. A successful preliminary meeting has been held at the premises of the Wharfedale Cycle Depot in Walkergate, when thirty-five prospective members were present. Plans for a workshop and library were considered, and the formation of a junior section was agreed to. The Hon. Secretary is Mr. N. Hall, 9, St. Clair Terrace, Otley.

Percival Marshall

A N accurate and reliable timepiece can rightly be considered as a most valuable asset to any home and for the amateur who wishes to construct such a timepiece, the synchronous electric clock offers an interesting example. Firstly, because it calls for none of the skill of the horologist to get it to keep good time, since, unlike other clocks, it requires no escapement of wheel or pendulum to control its accuracy. Secondly, it can be made robust enough for all the work to be carried out on the average model engineer's lathe and, lastly, if so desired, a rummage in the scrap box is more than likely to produce all the material needed.

The driving force of the clock is a simple synchronous electric motor taking current from the a.c. mains which deliver power, synchronised from Greenwich, at exactly 50 cycles per second. As the motor will always be running in step with the supply frequency and will neither lose nor gain on its designed speed, it will be obvious that with suitable reduction gearing, the hands of the clock will indicate the time being virtually controlled from Greenwich.

Such a clock is easy to construct successfully if one main point is always kept in mind, that being the very small amount of driving force available. The motor could, of course, be designed to give off more power, but that might adversely affect the electric light bill; as it stands the difference is barely perceptible. The synchronous variety of electric motor is not considered very efficient at any time and the small simplified version in an electric clock, made with material readily available to the amateur tends to lower this efficiency still further. Moreover, it being supplied with so minute a quantity of current, the



A SYNCHRONOUS ELECTRIC CLOCK

By J. W. PATTISON

output of power given off at the rotor shaft is bound to be small and calls for the utmost effort being made to reduce friction as much as possible. Any more power than that required to drive the hands of the clock is simply wasted.

Two such clocks were constructed by the writer and both proved very successful. By successful I mean they consume an absolute minimum of electricity, run very silently and, of course, keep excellent time. As to the latter, *no* credit can be given to the constructor, as one might say that, provided there is no slip in the mechanism, the clock will run and keep accurate time or it simply will not run at all.

One of these clocks is to be described in this article, the other is practically a half-sized edition and more suitable for use in a bedroom. The small one has a motor 1 in. in diameter running at a speed of 250 r.p.m., and has such additions as, for instance, a starting gear and a means of turning the hands from the back of the case, the coil windings and core section, however, remained the same in both motors, as these sizes had proved experimentally to be the most satisfactory in both the large and small clocks. Yet another difference was that in the small clock; the core was made detachable from the pole pieces to facilitate winding the coil.

The larger of the two clocks mentioned was designed for use in the kitchen, where a clock with a dial having bold hands and figures that could be read at a glance was considered essential. To be in keeping with its surroundings the outer case is made up in the form of a simple square box with a glass cover, which, when in place, renders the clock almost dustproof, yet should the current fail the entire case can instantly be removed by undoing two small catches. The hands are then turned to the correct time and assuming current is again being supplied, a flick given to the rotor,

which is very accessible, starts the clock, there being no great need for an outside starter on a kitchen clock.

The central position occupied by the clock in the kitchen coincided with a similar position in the dining room, which was on the other side of the wall. This was thought to be an ideal place for a timepiece to serve this room, so a suitable dial was made up and the hands connected up to the kitchen clock by a length of $\frac{1}{8}$-in. rod through a small hole bored through the wall, the latter being, as is usual for an inside wall, only one brick thick. Thus we have two dials, one in either room, served from the one clock.

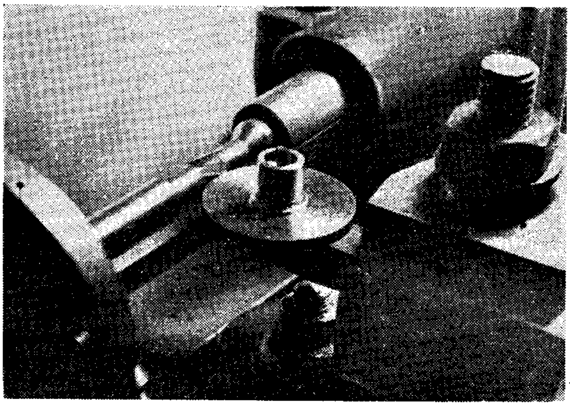
It might be mentioned here for the benefit of those who are on the lookout for ideas that it was originally intended that the clock be mounted on another wall of the kitchen and connected through to the hall which was adjacent. Here it was intended to fashion a modern dial suitable for the scheme of decoration consisting of large bold hands indicating the time against twelve circular discs in lieu of the usual figures. Large brightly-coloured erinoid buttons, originally intended to adorn ladies' coats, appeared to be just what was required. These were to be mounted on the wall without any glass covering, spaced around a circle of about 16 in. diameter. However, the scheme fell through owing to the greater need for a timepiece in the dining room.

If it is desired to make the clock serve as a mantel clock or in some similar capacity, it will be made more convenient if some means is adopted to start the rotor from outside the case, together with a knurled extension on the end of the minute shaft to alter the time. This was provided for on the smaller of the clocks mentioned. The shape of the outer case is, of course, immaterial to the working of the clock.

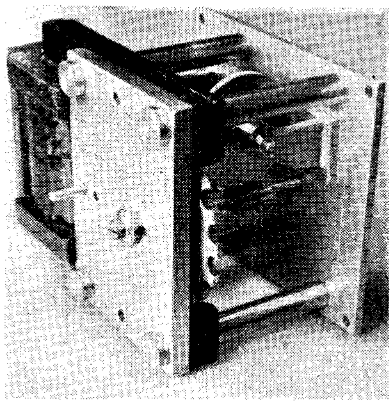
One of the first things to settle before starting construction is the speed at which the rotor is to run. The one to be described has 16 teeth or poles, which gives it a speed of 375 r.p.m. when connected to 50-cycle mains. This necessitates a reduction of 22,500 to 1, and is achieved by employing two sets of worm gearing each with a ratio of 150 to 1, which is some slight advantage when machining, as both gears are identical in all respects.

The speed of the rotor is dependent upon the number of pairs of poles it possesses and the frequency of the supply current to which the motor is connected and is easily calculated from the formula : $\frac{2 \times f \times 60,}{N}$ where f is the frequency of the supply mains and N the number of single poles on the rotor. It is useless to attempt to run the motor at intermediate speeds other than those derived from the formula, although it may happen that one of the speeds found will suit some odd gearing the reader may have in hand. The object of this article, however, is to give a short description of the entire clock works, including the simple means adopted to cut suitable gearing, which in use runs with a smoothness that is a delight to watch.

All the lathe work on the clock is elementary, although machining must be carried out with care if the resulting mechanism is to run smoothly and silently. No special apparatus is required, other than some form of dividing gear on the lathe mandrel ; given that the rest is straightforward.



Hobbing one of the worm wheels



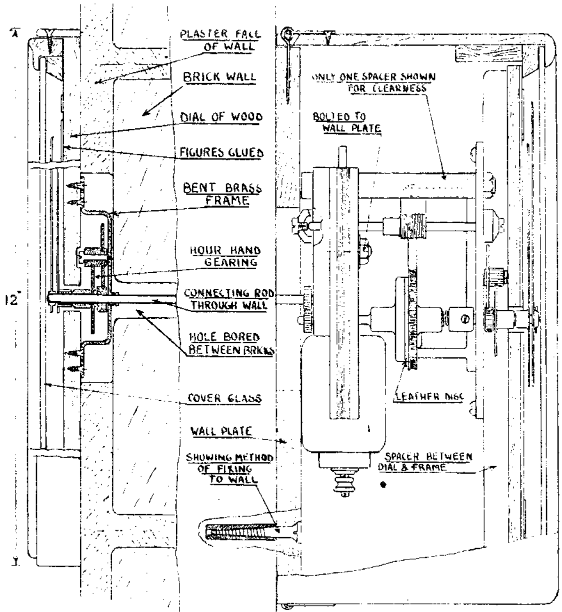
The motor and its gearing

To commence with the magnet or stator, take two pieces of $\frac{1}{8}$-in. sheet iron and sandwich between them sufficient thin sheet iron plates to make up a total thickness of $\frac{7}{16}$ in. when clamped up tight. The common black variety of iron will be good enough, or even tinplate for the thinner sheets, although annealed iron, such as is used for transformer stampings, would be better. Coat each plate with shellac varnish, drill and countersink as shown in the drawings and rivet up very firmly, afterwards filing the rivet heads flush. The shellac will be a benefit in preventing eddy currents as well as helping to cement the sheets into one solid block. File up the edges to the outline shown and, if you think the job warrants it, a facing cut can be taken off in the lathe, although if riveting hasn't caused damage and the plates are reasonably flat, this should be unnecessary.

If it is to be done, now is the time to do it before drilling any more holes. Having satisfied oneself that all is well, mark off the line AB and centre-pop the middle, then lay aside until the frames are ready.

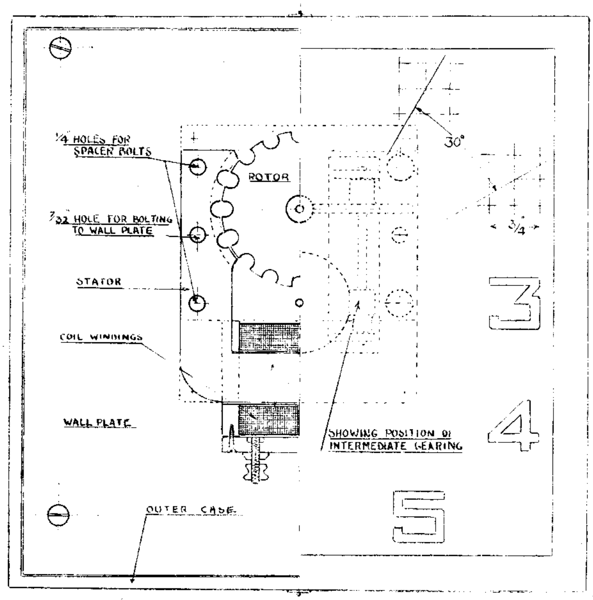
The frames must be of brass or some such non-ferrous metal, as they bridge the poles of the magnet. The rear one may with advantage be $\frac{1}{4}$ in. thick, as it holds the magnet yoke in position; the front plate is $\frac{1}{8}$ in. thick. Cut them to the dimensions given, file the edges true and square, and polish all over with fine emery paper. The holes for the spacers can be marked off on the rear plate and centre-punched. The magnet is then placed between the frame plates, taking care to position it carefully, and the whole lot clamped together for drilling. The four holes already centre-punched in the rear plate are then drilled through the pack and reamed. Make sure that the assembly rests flat on the drilling machine table to ensure that the drill penetrates true and square, otherwise the framework when erected may develop a slight twist. As a further precaution against such a trouble occurring, it may be advisable to pin-drill these holes just sufficient to remove any irregularities. Should the plates have already been faced up in the lathe, such a procedure will be unnecessary. Mark one side of each frame and the magnet so that they can always be replaced in their proper order. Having completed the work on the drilling machine, remove the front plate which would be on the bottom of the pack as it lay on the drilling table and, without turning it over, place it on top and locate with four dowels, made from short lengths of $\frac{1}{4}$-in. steel rod, pressed into the holes just drilled. The assembly can now be transferred to the lathe faceplate with the magnet yoke facing the tailstock. Run up the back centre into the pop mark which indicates the centre of the rotor tunnel and clamp firmly to the faceplate, the four dowels in the spacer holes locating everything squarely. A few heavy washers bolted to the faceplate opposite the assembly will effect a balance.

Whatever means you have for dividing may now be brought into use and set to divide a circle into 16 parts. Put a short stumpy drill about $\frac{1}{16}$ in. diameter in the chuck of the drilling spindle and bring the point to bear on the line AB at a radius of $1\frac{3}{16}$ in. from centres. Proceed to drill through the iron yoke until the drill point is felt entering the brass. Withdraw the drill and move the mandrel a sixteenth part of a revolution and drill as before, repeating the process until the circle of holes for the poles is completed. It



SECTION OF WALL & DIAL

SIDE ELEVATION OF CLOCK MECHANISM



SECTION OF COIL & STATOR

FRONT ELEVATION

is necessary only to drill the eight holes which form the poles of the magnet. Those forming the tips of the magnet cannot be drilled, but may be filed out later, whilst those forming the opposite ends may be drilled for convenience when hacksawing out the waste piece later. Open out all eight holes with a $\frac{1}{4}$-in. drill. The centre hole should then be drilled and reamed $\frac{1}{8}$ in. for the rotor bearings, running the drill right through both magnet and frames. Open out this centre hole in the magnet only, with the largest drill you possess, but taking care that it does not enter the brass plate underneath. With a tool held in the slide-rest commence boring the rotor tunnel, gradually opening out the hole until it is $2\frac{5}{16}$ in. diameter. Before removing from the faceplate, take a facing cut across the brass at the rear of the tunnel to clean it up and also chamfer the front rim, from the roots of the teeth to $\frac{1}{8}$ in. inside the tunnel. The chamfer on the rear rim can be performed with a file after the magnet is removed from the lathe, as accuracy is not essential and the file marks will not be seen when the motor is erected. Likewise, any blemishes caused by the drill breaking through into the brass when the serrations were being made will remain hidden.

After removal from the lathe, the remaining holes in the frames may be drilled and where necessary reamed. The waste piece of metal between the tunnel and core of the magnet can be removed by drilling a row of holes and hacksawing down to them, when the piece will easily break out. File up to the outline shown in the drawing and the magnet is then ready for winding. The bobbin to carry the wire is built on to the magnet and is a good deal more substantial than usual, as nothing is more annoying, after having wound on nearly all the wire than to find the bobbin ends about to collapse, when any remedy applied is more than likely to end in damaging the wire. The little extra trouble taken to make a substantial bobbin is more than amply repaid when the time comes to wind the coil.

The core is first wrapped with one thickness of card, a postcard is the right thickness, of sufficient length to allow for trimming up later when the ends are fixed. Glue the card to the core and make the overlapping joint on the side remote from the pole pieces. The bobbin ends are then cut from $\frac{1}{8}$-in. plywood and glued in position over this wrapping. Each end is made up of two such thicknesses of plywood and glued together when in place, to form a shallow groove to house the limb of the magnet, this detail being clearly shown in the drawings. Another single wrapping of card is then glued over the first, but this time it is cut to be a neat fit between the bobbin ends. When the glue has set trim the first wrapping flush with the outer ends and give the whole lot a coat of shellac varnish and leave to harden.

For 220-volt mains the winding consists of 9,000 turns of 40-gauge enamelled wire and this extremely fine wire needs care in handling, as it is very easily snapped. To wind the coil, the magnet is best gripped in the four-jaw chuck, with the axis of the core running as near as possible between lathe centres. With the normal 3-in. lathe the overhang of the chuck, plus the magnet, will be greater than the gap and as the distance from the core axis to the pole tips is more than 3 in. it will foul the lathe bed. The only remedy is to move the magnet over in the chuck, when the core will run with an eccentric motion, but will still wind satisfactorily provided the axis of the core remains parallel with the lathe centres.

Turning by hand will probably be the safest method of winding, although undoubtedly the most tedious. Power may be used, but only if the lathe can be started and the speed increased gradually, as the slightest jerk will almost certainly snap the fine wire. The reel holding the stock of wire can be mounted at any convenient spot in line with the bobbin, making sure that it runs quite freely. Remove the enamel covering from one end of the wire for a distance of about 18 in. by gently pulling it through a folded piece of fine emery paper. Double the bare part back upon itself three times and twist the resulting eight strands together to form a cable $2\frac{1}{4}$ in. long. Drill a hole in the bobbin end near the core, thread a short length of systoflex or other similar insulating tubing through the hole, leaving about $\frac{1}{8}$ in. protruding inside the bobbin, then thread the stranded end of the wire through the systoflex. A turn or two of thread wrapped around the stranded wire and its covering will hold it securely to the core. Start up the lathe or turn it by hand, meanwhile guiding the wire on to the bobbin with the left hand. Endeavour to wind as evenly as possible and take great care when the winding approaches the bobbin ends, as it is liable to catch on the revolving pole pieces.

After 2,000 turns have been put on, wrap a layer of tissue paper over the wire and continue, inserting a similar layer at each 2,000 turns. Finish off the coil by baring the wire and making another stranded end as at the commencement, bringing out this end opposite to the start. Soak the coil in shellac varnish and leave in a warm place until thoroughly dry, then cover with a strip of leatheroid for protection. A piece of ebonite screwed to the bobbin ends and having two terminals for attachment to the wiring will complete the magnet.

The four distance pieces or spacers can now be parted off to length from $\frac{1}{4}$-in. internal diameter thick-walled brass or copper tube. Face the ends square in the lathe and make sure they are all of equal length. It may be as well to run a $\frac{1}{4}$-in. reamer through each in turn to clean them out. Make up four bolts to fit them from $\frac{1}{4}$ in. diameter brass or steel rod, screwing the ends just sufficient to accommodate the nuts. Run a brass nut on one end of each and turn down in the lathe to $\frac{3}{8}$ in. diameter and face off the end until it is left $\frac{3}{16}$ in. thick. The other ends are ultimately secured with thin brass nuts.

Erect the framework and stator to ensure that all is square, when the nuts are pulled up tight. The rotor and minute hand arbors are cut from $\frac{1}{8}$-in. diameter ground steel rod. Insert them in their respective bearings to make sure there is no binding. If all is correct, the rotor can now be taken in hand. A solid rotor cut from $\frac{1}{8}$-in. thick steel plate proved more satisfactory than one made with laminations.

(To be continued)

"L.B.S.C."

THIS WILL BE *SOME* RAILWAY!

YOUR humble servant has already had a few words to say about the club which built the pioneer outdoor track at Romford, and about that enterprising "Brotherhood of Live Steamers" over the big pond, who travel hundreds of miles to their big annual "do," and have put up what is, to the best of my knowledge and belief, the longest line of its kind in the world. Well, this week it gives me exceedingly great pleasure to chronicle the doings of a young but very enthusiastic and energetic club up in the North of England; and I think this one, in the words of their own genial secretary, "caps 'em."

The West Riding Small Locomotive Society—grand title, that!—has been in existence for under two years, but during that time it has enrolled a bunch of members who are really and truly worthwhile enthusiasts. There is a well-known and very true saying that "actions speak louder than words"; the actions of the W.R.S.L.S. don't speak, they just yell out loud! In the short time the club has been in being, reckoning from its inception up to the middle of last November, when a "census" was taken, there were sixty-five locomotives on the register, either complete or well advanced in construction. I believe there are more both at Malden and Birmingham; but at those centres, the clubs have been in existence a much longer time, and the membership is proportionately greater.

Locomotives are of no use without a decent line to run on; and it is in this connection that the Yorkshire lads have made up their minds to score. They don't aim at having the longest nonstop road, but they do intend it to be the most substantial, trouble-free, and everlasting; and the reproduced photographs, kindly submitted by the secretary, Mr. W. D. Hollings, give a pretty good idea of how the work is being carried out, and what the road will be like when opened for traffic. The site was far from being level, so the route was surveyed and plotted out exactly the same as a full-size railway, by aid of a theodolite plus the usual blobs and gadgets. The complete circuit will be 660 ft., less a few inches; maximum gradient 1 in 200, and minimum radius of curves, 60 ft. There will be five rails, giving gauges of 2 in., $2\frac{1}{2}$ in., $3\frac{1}{2}$ in., $4\frac{13}{16}$ in., 5 in., 6 in. and $7\frac{1}{4}$ in. Personally, I am glad to see the correct gauge for "1 in. scale" locomotives included; one-twelfth-full-size engines on 5-in. gauge, when viewed end on, have the same "straddled-out" appearance which is a well-known feature of the dearly-loved "half-inch-scale-$2\frac{1}{2}$-in.-gauge" locomotives shown in some

Photo by] [*Overend Press*

The full-size way of doing the job!

commercial catalogues, to which Mr. J. N. Maskelyne called attention many years ago.

Owing to the nature of the ground, part of the line is in a cutting, and as this necessitated some heavy excavation work, mechanical aid was enlisted, as the photographs will show. Even after the machine had done the "donkey work," there was still a tidy bit of hand shovelling to do, before the supports for the railway could be installed. The railway itself takes the form of a very substantial concrete viaduct, the spans being mounted on pillars pitched at 8-ft. centres. The whole doings was specially designed by an architect, and has sufficient strength to carry a $7\frac{1}{4}$-in. gauge 4-6-2 locomotive weighing nearly half a ton. Inspector Meticulous himself would be hard put to it, to find anything wrong with its personal appearance on the score of realism; just take a look at the picture of the high span, and it is hard to realise that you are looking at a miniature railway in course of construction, and not a full-size double-track viaduct being erected over a rocky gorge! The concrete pillars on which the spans rest are 18 in. by 12 in. in section, and these are set on concrete slabs, 2 ft. square, minimum thickness 6 in., cast in position on the clay. Great care was taken to see that the foundations were well and truly laid, so that there would be no chance of subsidence, and the line would maintain both its level and alignment for an indefinite period.

The rails are not of the usual pattern, but are rectangular tubes of 1 in. by $\frac{1}{2}$ in. section, the walls being $\frac{1}{8}$ in. in thickness. They are held by steel ties, of channel steel $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. by $\frac{3}{16}$ in., gang-milled to receive the rails; these ties rest on wooden sleepers to give a certain amount of resiliency. The complete sections of rail, when assembled, are bolted down every two feet with "through" bolts; the method of "casting in" the holes for these can be seen in one of the pictures.

Mr. Hollings says the civil engineering side of the business has been pretty tough—I can well believe that!—but, as the song says, "It's all over now," and the rest of the work to be completed is all straightforward. There have been, of course, the usual "moans and groans" from self-appointed critics who are out to find fault with everything; most folk know the type. The line is neither "scale" nor the rails correct, and there is no resilience and all the rest of it. Maybe not; but the members of the West Riding Small Locomotive Society intended to have a railway that was really a "permanent way," on a structure of cast-iron rigidity, free from all the usual ills of the "scale" line, such as winding, twisting, switchback effect, subsidences, derailments, and a garden of weeds growing through the roadbed. I guess they will have their desire when the line is complete, and jolly good luck to them, with hearty congratulations on their enterprise. They are shortly holding two exhibitions: one at Bradford, from March 7th to 15th, and the other at Leeds, from March 19th to 22nd, and kindly invited your humble servant to be present, saying that I am partly responsible for their existence, a generous tribute which I very much appreciate. However, Curly's visiting days are over except to personal friends; with the passing of the years, the old childhood shyness has returned, and I couldn't face an exhibition. If all goes well, and our friend the K.B.P. has no objection, some of the members' locomotive work will be illustrated next week.

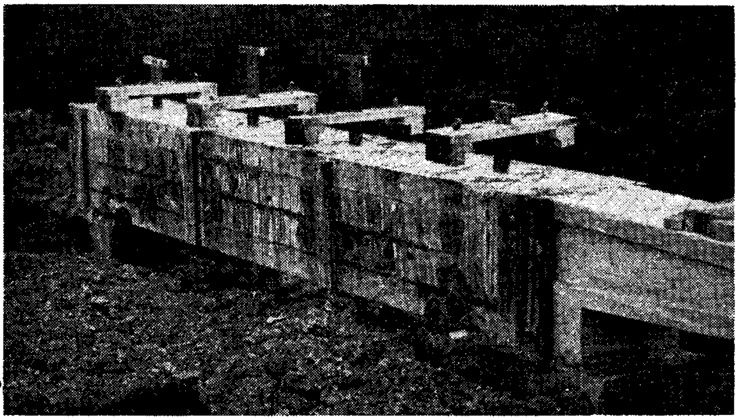
And Yet Another!

A few evenings ago, time of writing, the telephone bell rang, and on picking up the receiver, the voice of Mr. S. Hill, of Bonvilston, near Cardiff, came through. After a cheery greeting and expression of good wishes, Mr. Hill announced that the day had seen the opening of his new line, and everything had gone off satisfactorily. Our worthy South Wales friend is a quarry owner, so has the material for building a railway ready to hand; and by all accounts he has made exceedingly good use of it. He has promised to forward full details and some photographs as soon as available, meantime suffice it to say that this line also is a continuous concrete viaduct with plenty of "meat" about it. He adopted a different idea from that already mentioned, laying his rails on sleepers, and concreting over the whole bag of tricks, right up to railhead level, merely leaving grooves for the accommodation of the wheel flanges, so that the permanent way bears a strong resemblance to a street tramway line. Mr. Hill says that there is no fear of any part of the track getting out of level or alignment.

Our friend confessed that he had often thought my accounts of long nonstop runs on my own road were somewhat exaggerated; now, he says, it is the other way about! He was amazed at the first long nonstop run of his own "Molly" on the new line; he says she just reeled off lap after lap (the circuit is about 350 ft.) with absolute ease, maintaining steam pressure without effort, and using little coal. After that, a friend's "Petrolea" was put in steam, and that lady proved a veritable "ground flying machine," knocking off one lap in 24 seconds, which is about the limit for the curves. Incidentally, several correspondents who have built "Petroleas" say that the manner in which such an engine of moderate dimensions can get away with a load, and the steaming capacity of such a small boiler, is a real eye-opener to the uninitiated. Well, it's just what I said in the little lobby chat about combustion chambers; if the grate area, firebox volume, size and diameter of tubes, and so on, are properly proportioned, the boiler will make the steam, irrespective—within reason, of course—of its size. Jimmy Holden knew what he was about when he designed the big sisters, and they did the job. As the engine I described had boiler and cylinders in the same proportion, she could do the job too; and the credit is not mine, but is due to "Bro. James of Stratford." My engine was just a one-sixteenth edition of his; and that brings us to a complementary subject, about the building of old-timers.

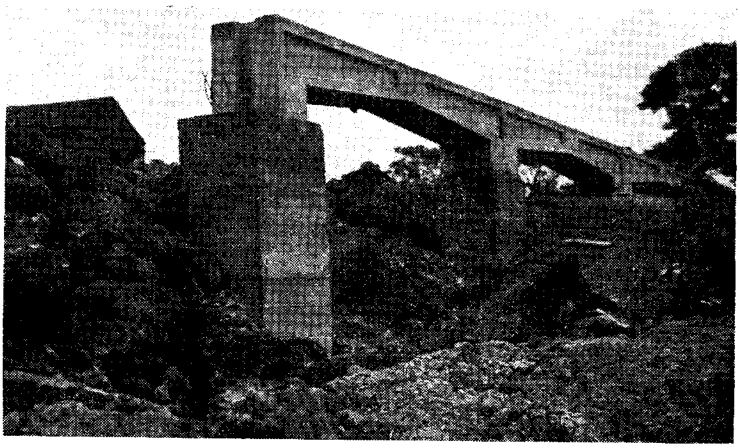
Resurrecting Old Designs

It has been suggested in the correspondence columns that some of the older locomotive designs should be reprinted, among them the "Dunalastair" design of over forty years ago,



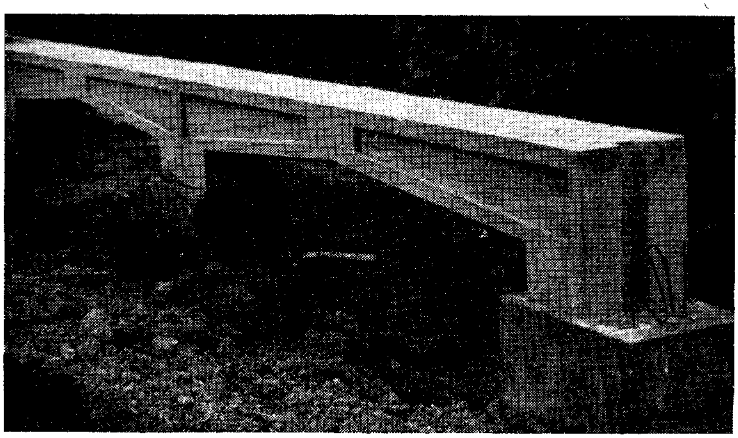
How the sections were cast

shouldn't have dreamed of building the $3\frac{1}{2}$-in. gauge "Jeanie Deans," nor should I now be at work on old "Grosvenor," and fretting because I have not as much time available to get on with the job, as I would wish. What I aim at is just this: all my life I have been doing my level best to improve the general efficiency of the little locomotive, and for the last 22 years have laid before builders of these fascinating midgets the results of my personal experience, with the



Sixty feet high—or six?

and the G.W.R. 4-4-0 "Gooch." I don't know what followers of these notes think about it, nor do I know if our good friend who wields the blue pencil agrees—he isn't responsible for my opinions, anyway; they would land him in too much hot water!—but to your humble servant the idea seems akin to printing a dissertation on how to make bows and arrows, in the current issue of the "Daily Atom." Please don't run away with the idea that I have any prejudice against the old engines; I love them, otherwise I



Photos by] [*Overend Press*

Solid, substantial and thick!

result that the engines built to-day do what was considered not only impossible, but ridiculous to contemplate in the days when the two designs cited at the beginning of this paragraph were published. Therefore, it appears to me to be only a waste of space to resurrect designs and methods of construction that are as dead as the dodo. It might be interesting to compare those designs and methods with to-day's practice.

I have not the old volumes of this journal in which the articles appeared, so cannot give any specific dimensions; but to the best of my recollection, the Caledonian engine had a loco-type boiler with a few large tubes, and the firing was by Primus paraffin burner. I recollect there was once a bit of a controversy as to whether pinching in the sides of a "silent" type Primus burner made any difference to its efficiency; the burner was too large to fit a $3\frac{1}{2}$-in. gauge firebox as sold. The engine had neither superheater nor mechanical lubrication; the cylinders were in accordance with the then generally-accepted theory that the bore should not exceed the "scale" of the engine, that is half-inch bore for half-inch scale, and so on. The frames were thin, and the whole construction, though good for the period, was not suited for the work a similar sized locomotive is expected to do—and keep on doing—to-day. One of these "Dunalastairs" actually did manage to do a spot of live passenger-hauling, when the S.M.E. held their meetings at the Holborn Town Hall in the early 1900s; she struggled the length of the track with no less a person than our worthy "superintendent," Mr. P. Marshall, who can thus (to the best of my knowledge and belief) claim to be the first adult passenger to ride behind a $3\frac{1}{2}$-in. gauge locomotive in public.

The Difference

Now your humble servant rebuilt an old "Dunalastair" for that genial person who hides his identity under the nickname of "Bill Massive." This engine was of later vintage than that mentioned above; she had a bogie tender, feed pump and other later additions, and was illustrated recently in these notes. I fitted one of my own pet coal-fired boilers to her, opened out the cylinders as big as the castings would allow, altered the valve gear to "Live Steam" specifications, and had a general titivate-up. What was the result? With sustained working pressure, superheated steam, mechanical lubrication and proper valve events, she could handle a load that the engines mentioned in the correspondence columns couldn't tackle; and instead of a single adult being the limit of its power, such a load was a mere featherweight, the engine running best part of a mile on one firing, with the lever almost in the middle, and only a crack of regulator opening. Such being the actual facts, where on earth is the sense of building an engine of similar outline to an outmoded design? I wonder what Mr. Bulleid would say if somebody suggested that he built a locomotive to the design of the old Canterbury and Whitstable "Invicta," which defied Jerry and all his works, and still stands unharmed among the desolation near Canterbury station!!

Build a $3\frac{1}{2}$-in. gauge "Dunalastair" if you fancy its personal appearance; but for the boiler and "works," follow "Live Steam" specifications. Make the frames of $\frac{1}{8}$-in. steel, and the buffer and drag beams of 1-in. by $\frac{1}{8}$-in. angle. "Molly" hornblocks and axleboxes would come in, and the wheels can be "scale"; driving wheels $4\frac{7}{8}$ in. diameter, and bogie wheels $2\frac{5}{8}$ in. diameter. The later "Dunalastairs" had 19 in. by 26 in. cylinders, so you can make yours $1\frac{3}{16}$ in. bore and $1\frac{5}{8}$ in. stroke; and as there isn't sufficient room between the bores for a steam chest of adequate size (or indeed any size at all!) put the valves on top and drive them with "Molly's" link motion with the rockers upside down. The weighbar shaft can be placed higher, and the lifting links lengthened to suit. "Molly's" crank axle will do fine. As to the boiler, this was 4 ft. $8\frac{1}{2}$ in. on big sister, so all you have to do is to copy the boiler, section of firebox and arrangement of tubes that I specified for "Petrolea," lengthening the firebox to suit the Caledonian engine. Keep the same proportion of blower, blastpipe and chimney, and fit a "Molly" injector for boiler feed. The rest of the doings doesn't signify a Continental; you can use a six-wheeled or bogie tender as preferred the former being better, as the handles are easier to reach from the driving car. Don't forget a mechanical lubricator with a $\frac{1}{8}$-in. ram; "Juliet's" would do very well. An engine such as briefly outlined above would steam and pull in a manner calculated to make the spirit of old John F. McIntosh rejoice and be glad, running away with half a dozen passengers without thinking twice about it—something the one described in the early 1900s in this journal could never do in a million years!

In passing, every Scotty knows the sound of the Caledonian hooter. A similar noise-machine—you can't exactly call it a whistle—is used by the L.M.S. and also on the Ministry of Supply "Austere Adas." One of the latter, for some weeks past, has been working a down goods train past our hacienda every evening; and recently, when the Purley "distant" was on, she loosed off a terrific blast. My fair lady, who was in the kitchen at the time, called out, "Here comes the *Queen Elizabeth*!" The sound of this distinctive gadget had not, to the best of my knowledge and belief, been reproduced on a little engine before your humble servant managed it. I'll leave you to guess how it was done, and then, if nobody gets the solution, I'll tell you; and all owners of L.M.S. engines can make them kick up the genuine row. One word in your ear before leaving the subject of the "Dunalastair"; if you build one, don't forget to hang a lamp on each side of the cab, and put the "Caley" semaphore route indicator on top of the smokebox in front of the chimney, or that wonderful magician of the pencil, locodelineator F. C. Hambleton, will never, *never* love you any more!

"Gooch" Up to Date

Turning to the other engine mentioned, the G.W.R. 4-4-0 "Gooch," this was specified with a water-tube boiler fired by a Primus burner, the usual tiny cylinders, and Joy valve-gear with the usual small ports and short travel valves. Now I

(*Continued on page* 347)

SYNTHETIC RESIN CEMENTS

Their application to Model Shipbuilding

By R. B. Rashbrook

SINCE I first became interested in model shipbuilding, and, more particularly since I began using the rib-and-plank method of construction, it has seemed to me, as it must have to many others, that one of the chief necessities for this work is a really reliable glue. I had already tried several of the more common brands of glue and rejected them on the grounds of insufficient strength, poor water resistance, and long setting-time. Hide glue was naturally out of the question, not only on account of its many defects as a glue, but, mainly, because of the great practical difficulties attending its use. Driven further afield, I tried casein glue. This I found to be very strong but extremely slow-setting. Moreover, although it is almost always described as "waterproof," in point of fact it swells up into a kind of jelly and loses all its strength when brought into contact with water. Again, ordinary casein glue, with certain hardwoods such as mahogany, produces unsightly staining which is difficult to remove. Finally, after I had almost resigned myself to using balsa cement, I decided to try synthetic resin adhesives.

My attention was drawn to these glues by references to the resin-bonded plywoods extensively used in the late war for light coastal craft and aeroplanes, such as, to quote perhaps the most famous example, the Mosquito. I discovered that there are two types of synthetic resin cements, namely the phenol-formaldehyde ("Bakelite") and the more commonly-used urea-formaldehyde. On the whole, I think it is true to say that the latter is more generally suited to the purposes of the model shipbuilder.

Urea-formaldehyde cement is obtainable in different forms according to the nature of the filler incorporated with it, but the pure material is a translucent or milky liquid with a characteristic pungent smell of formaldehyde. Provided that it is kept in a cool, dry place, it will remain fairly mobile for some weeks. After a time, however, it gradually becomes more viscous and finally assumes a rubbery condition. When heated to about 135 deg. C. or on the addition of a "hardener," it quickly becomes jelly-like and finally sets to a hard mass which, unlike the original liquid, is not affected by water. Most firms will supply a variety of hardeners (usually coloured) to bring about rapid or slow setting, as required. Typical setting times with one type of hardener are :—

	Approx. working life	Approx. time under pressure
At 60° F. ..	$1\frac{1}{2}$ hours	6 hours
At 70° F. ..	$\frac{3}{4}$ hour	3 hours
At 80° F. ..	1/3 hour	$1\frac{1}{2}$ hours
At 90° F. ..		1 hour

For modelling work a combination of heat and hardener produces good results. A useful procedure to be adopted is as follows. The cement is mixed with about $\frac{1}{16}$ its weight of hardener in a glass jar—the kind used for shaving cream and cosmetics is very suitable. The jar is kept as cool as possible, e.g. by standing in an outer vessel of water, and in this way one batch of glue can be used for several hours. The cement is applied in the usual way with a brush or piece of stick and the joint put under pressure if possible. Then by placing the assembly in front of the fire, on a radiator, or in sunlight, the time of setting can be reduced to about five or ten minutes.

There are, of course, some disadvantages connected with the use of these cements. The most obvious is the necessity for continually mixing small quantities of glue. This can be partially avoided as explained above. In spite of all precautions, however, it is almost impossible, particularly in warm weather, to avoid wasting a certain proportion of the glue, and beginners should be careful to mix only as much as they require for the job in hand. Another drawback is the difficulty of removing surplus glue from the mixing pot. It is better to allow this to set, when it can usually be dug out in one piece with a knife, than to attempt to remove it in the jelly stage, a process which will only result in the covering of one's fingers and every object within reach with a sticky mass of glue. Incidentally, any glue which gets on the fingers should be washed off at once, before it can set.

Against these disadvantages can be set a whole host of good points. Most notable perhaps is the amazing strength of these cements. A properly made joint which has been allowed to season for two or three days will withstand tremendous strains, and even when breakages do occur they are almost always in the wood itself rather than in the glue. Another most useful property is their water resistance; certain special varieties can be obtained which will withstand boiling water. Lastly, there is the versatility and adaptability of these cements. The more viscous types can be mixed with wood-flour or fine sawdust to give a hard, water-resisting and non-crumbling plastic wood. With sand, plaster of paris, zinc oxide, etc., they provide a range of different materials suitable for the construction of model harbours and the like. Phenol-formaldehyde cements can be thinned with methylated spirits to form a varnish which can be used, for example, to coat the interior of sailing models. Further experiments should find many other uses for the glues along the lines indicated.

Most of the data given refer to urea-formaldehyde cements, although they are, in the main, true, for phenol-formaldehyde cements as well. The handling of the latter, however, calls for some experience. They set less easily, and the hardener used is a strong acid and corrosive. Their main use, I think, will be for sailing models where extreme strength and water resistance are required. Because of an acute shortage of phenol too, supplies will be restricted for some considerable time to come.

I would like to say that I have always found the manufacturers very helpful and always ready to supply one with useful literature about them.

Models at the Shipwrights' Exhibition

By Edward Bowness

THE exhibition recently held by the Worshipful Company of Shipwrights at the Agricultural hall was a veritable feast for the ship modeller. On entering the large hall, the first impression one received was that there were models of liners on every stand, due no doubt to the effect of the imposing model of the *Queen Elizabeth* on John Brown & Co.'s stand, and of the liners *Strathmore* and *Monarch of Bermuda* on the stand of Vickers-Armstrong, both of which were near the entrance. On working around the stands, however, one began to realise what a bewildering variety of ships is being built and used in these days. This is an age of specialisation, and ships seem to be more specialised in their design than are most things; the difference between a battleship and a liner is not more striking than the difference between certain types of Merchant Navy ships.

To the model maker, all this opens up an immense field, and the choice of a prototype becomes a rather difficult matter; at the same time this choosing of the prototype for a model can be a very fascinating business, affording an excuse for examining models and photographs of all kinds of ships. The Shipwrights' Exhibition provided an ideal opportunity for considering the possibilities of the various types as prototypes for models.

To begin with, the earliest known types, a series of models of the Ark of Noah gave one much food for thought. Was this a ship as we understand the term, or was it merely a raft built with a sheltering structure to protect the inmates? Most of the competitors took the latter view, although the models showed a considerable difference of opinion as to the nature of the shelter provided. We ourselves favour the raft theory as being the most probable, as the Ark would simply float off the ground as the water rose, and again, the ship-like nature of some of the models exhibited seems rather too advanced for the period.

On the stand of the Glen Line was shown a series of plaques on which were painted excellent pictures of ships from the earliest times down to the present. These were worthy of careful study by the model maker with an interest in the development of the ship, and it would be very helpful to the model maker if they could be reproduced and made accessible.

There were several bone models of the prisoner-of-war type. One represented a ship of 1670 or thereabouts—a somewhat unusual period for this type of model. This was rather a small model and the detail work in both the hull and the rigging was very good. Another example was a model of H.M.S. *Victory*, of which we reproduce a photograph, and in this, whilst the hull was somewhat rough, the rigging was notable in its completeness, although in places it was a bit heavy. It had the appearance of having been re-rigged at a date considerably later than that of the building of the hull.

There were four models of the later sailing ships, and all were excellent examples of shipyard models. The model of the well-known passenger ship *Torrens* on the

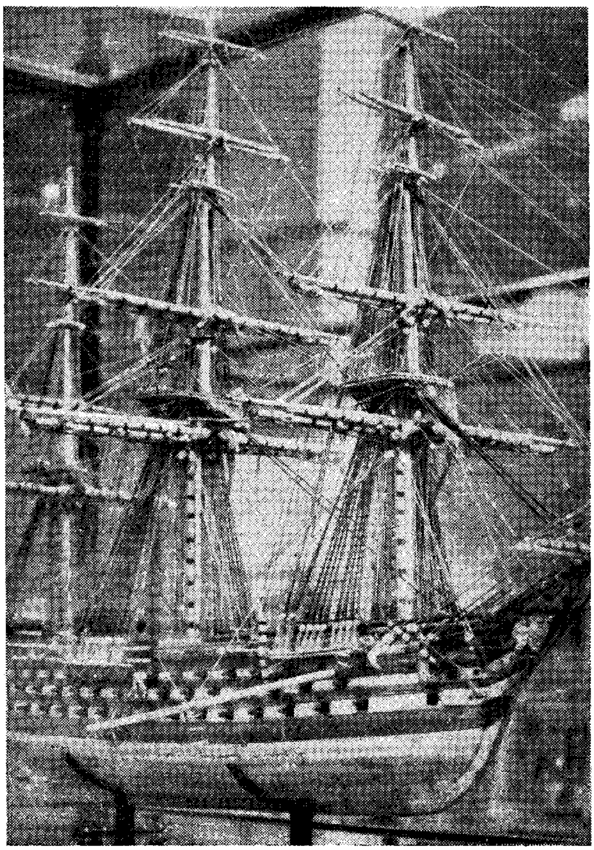


Photo by] [*M. B. Craine*

Bone model of H.M.S. "Victory." Scale $\frac{1}{8}$ in. = 1 ft.

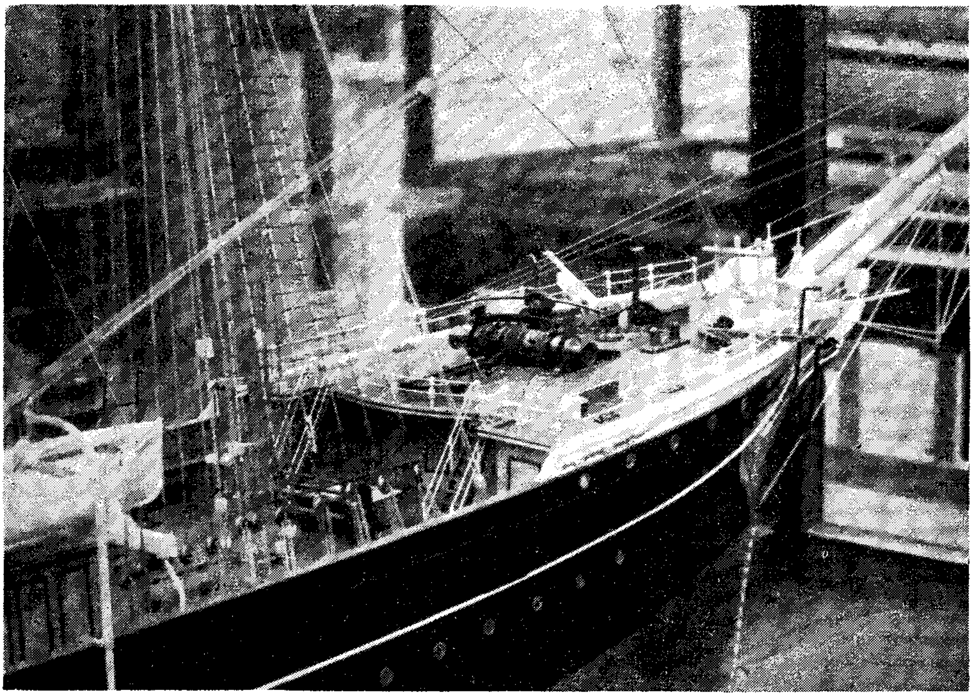


Photo by] [*M. B. Craine*
Fo'c'sle of ship "Torrens" from model by the builders, Sir James Laing and Sons Ltd., Sunderland

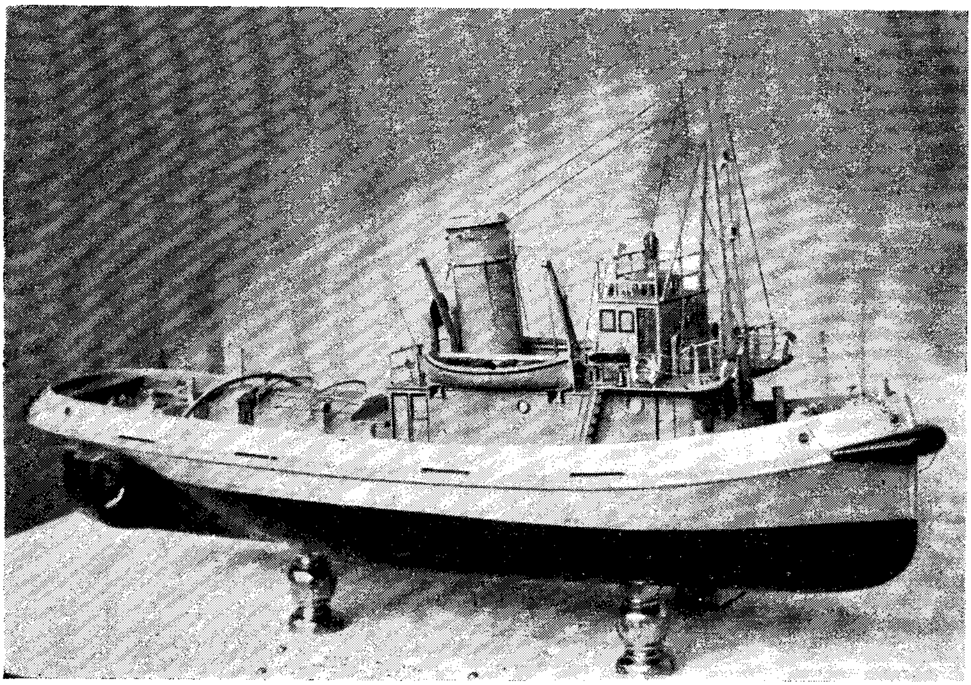


Photo by] [*M. B. Craine*
Steam tug "Empire Ariel." Builders: Richard Dunston Ltd., Thorne, nr. Doncaster

stand of Sir James Laing & Sons, was a magnificent example of the sailing ship model and worthy of the fine ship it represents. The accompanying photograph shows a close-up of the fo'c'sle head. It is a curious fact that all four sailing models represented ships built at Sunderland, the other three models being one of the barque *Brierholme*, of Maryport, and two of the four-mast barque *Mowham*. We noticed on one of the *Mowham* models that she was provided with the modern stockless anchors

Coming now to the models of modern ships, one is impressed by the fact that each type has a beauty of its own; which is only another way of saying that a structure such as a ship, a locomotive, a machine, or even a piece of mechanism, when properly designed with the object of performing its proper function, has a rightness and a fitness about it which satisfies both the eye and the mind. The grace and beauty of a merchant liner, the grimness and strength of a battleship, the severe utilitarian efficiency of a tanker, and the snug compactness of a motor coaster, each have their appeal to the model maker, and each, in their way, makes a very satisfactory prototype.

For a working model, one inclines to favour the smaller type of ship such as the tug, the trawler, the coaster, the small passenger steamer—screw or paddle—and the cabin cruiser, the chief reasons being that the details are larger and more robust, that less distortion is required to give the necessary displacement, and that the machinery is more easily accommodated. There were innumerable examples of all these types at the Exhibition. Some of the motor coasters such as those on the stand of Henry Robb Ltd., of Leith, make very intriguing models and would look well on the water. A Diesel trawler, the *Thorina*, on the stand of Cook, Welton & Gemmell Ltd., had a very smart, modern appearance and would make a very attractive model. Richard Dunston Ltd., well-known as makers of modern tugs and coasters, showed some fine models of this type, two of which we illustrate. The exhibits on Samuel White's stand included a fine model of the first all-welded British destroyer which, if modelled to a fair size and given a little extra beam and depth, would have great possibilities as a high-speed displacement boat. That brings us to the models of high-speed craft, such as those on Thornycroft's and Vosper's stands. The air-sea rescue launch and similar types are already great favourites as models, and it was interesting to see accurate representations of their prototypes. On Thornycroft's stand an interesting comparison was afforded by the model of the first torpedo boat, H.M.S. *Lightning*, 1876, $18\frac{1}{2}$ knots, and that of H.M.S. *Brecon*, a Hunt class destroyer of 1942. The reproductions herewith are not to the same scale but will enable the reader to see how the type has developed.

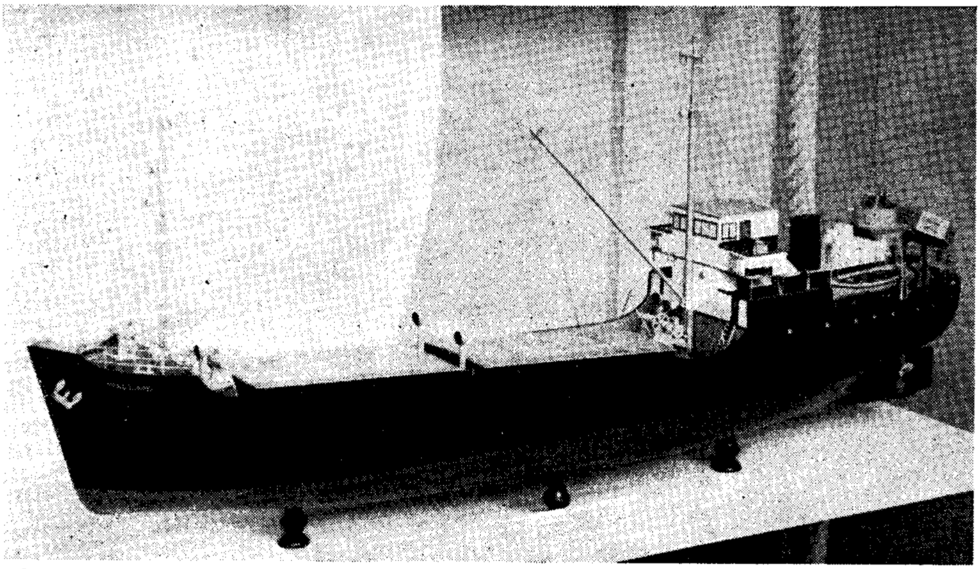


Photo by] [*M. B. Craine*

Diesel coaster "Mallard." Builders: Richard Dunston Ltd., Thorne, nr. Doncaster

Tankers, both large and small, are in a class by themselves. Having to place the funnel aft is rather a difficulty with a model powered by a steam engine, but to overcome this should not be beyond the wit of most model makers The advantage of a tanker as a working model is that it has a low freeboard, and seeing that one can exaggerate the draft without affecting the appearance on the water, the centre of gravity may be kept low enough to produce an exceedingly stable and sea-worthy model. As to appearance, a well-designed tanker in real life is as impressive a ship as anything that floats.

Models of fighting ships are always popular, but those in the Exhibition were almost frightening from the model maker's point of view in the amount of detail included. Such a model, if

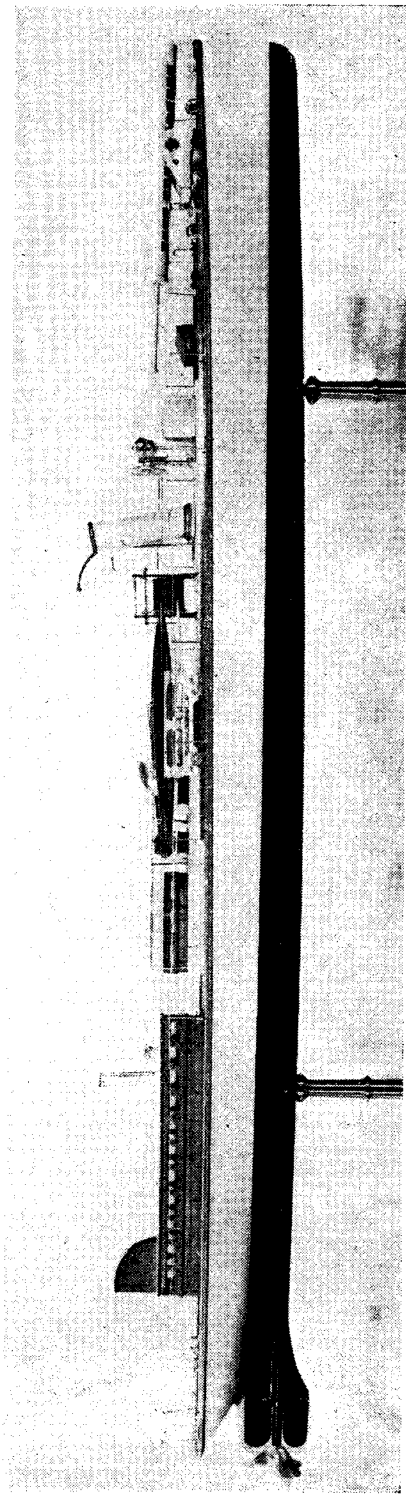


Photo by courtesy of [*John L. Thornycroft and Co. Ltd.*

H.M.S. " *Lightning* " (1876). *Torpedo boat No.* 1 *of the British Navy*

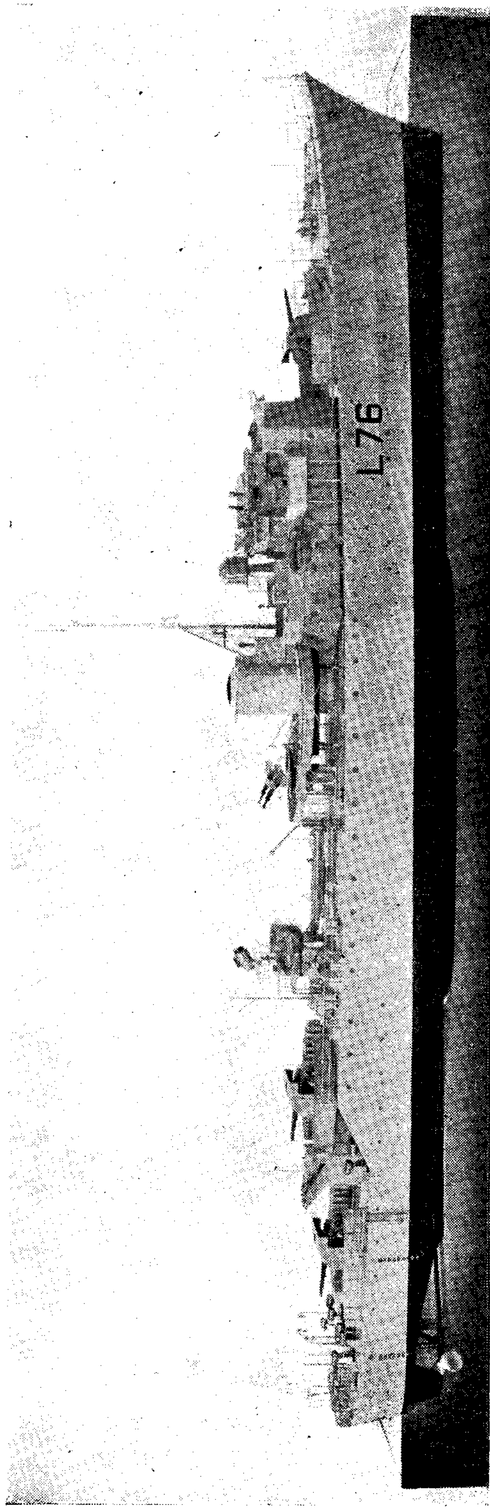


Photo by courtesy of] [*John L. Thornycroft and Co. Ltd.*

H.M.S. " *Brecon* " (1942). *Hunt class torpedo boat destroyer*

designed for sailing on a pond, calls for great skill and discrimination in the elimination of unnecessary detail. The great thing is to preserve the characteristic outline, and as this is usually formed by the innumerable details, it is far from easy to produce the effect required.

An interesting feature of the Exhibition arising out of the changes which have been taking place almost imperceptibly in recent years was the large number of cargo-passenger steamers or cargo liners shown. Some years ago the cargo and the passenger ship were two distinct types, but now they are merging into each other. The result from the model maker's point of view is that we have a prototype which has sufficient passenger accommodation to make it a smart-looking ship, without the endless repetition of promenade decks, stanchions, windows and lifeboats that make a model liner such a monotonous ship to tackle. Several of the examples of cargo-passenger steamers would make very attractive models, whether for exhibition purposes or as working models.

The models of the purely passenger liners such as *Queen Elizabeth*, *Mauretania*, *Strathmore*, *Orion* and the exceedingly smart Union Castle liners, attracted most of the attention from the general public, and rightly so, for they are designed to have a smart and impressive appearance; but to the model maker they represent hours of monotonous labour and are more easily made by the professional with his resources of machine tools and die-cast fittings.

Speaking of professional model makers reminds us that most shipyard models are made by men who have graduated into the job by way of an enthusiasm for model making in their youth. One such I met, Mr. Gateshill, has been making models for the Caledon Ship Building Co., of Dundee, since 1904. He told me he had no less than eight of his models in the Exhibition. The plated metal fittings were made by specialists in metal work, but the remainder of the work was his, and the hulls were planned and carved in the good old way. Most of them were to the usual scale of $\frac{1}{8}$ in. = 1 ft., but one, surely his masterpiece, the *Telemachus* of the Blue Funnel Line, shown on Alfred Holt & Company's stand in the small hall, was to $\frac{1}{4}$ in. scale. The panelling around the bridge and of the superstructure generally, and the work in the deck, with each plank to the correct scale width of 5 in., and each laid separately with covering board all round, was as fine and as delicate work as I ever hope to see. Congratulations, Mr. Gateshill, on a very fine series of models! The point for the model maker is that what one man can do, another can, provided he gives the same amount of painstaking application to the job.

Just a word in conclusion about engines. There were very few engine models on the stands. One notable example was that of one of the four 8,000 b.h.p. Doxford engines installed in the *Dominion Monarch*, which is the highest powered mercantile motor ship in the world. This is of their well-known opposed-piston type, with bedplate, columns, etc., made entirely of welded steel. As the accompanying photograph shows, this was a beautiful example of the model maker's art, and it gave one an opportunity of examining an unusual type of engine at close quarters.

Another interesting engine model was that of a typical triple-expansion steam engine, which was shown installed in the stern framing of a ship complete with thrust block, tail shaft and propeller. This was on the stand of the North Eastern Marine Engineering Co., of Wallsend-on-Tyne. We hope to publish a photograph of this model in an early issue. This firm also showed a model of a 7,500 s.h.p. turbine installation, but somehow the turbine hasn't the same appeal to the eye of the model maker as has the reciprocating engine.

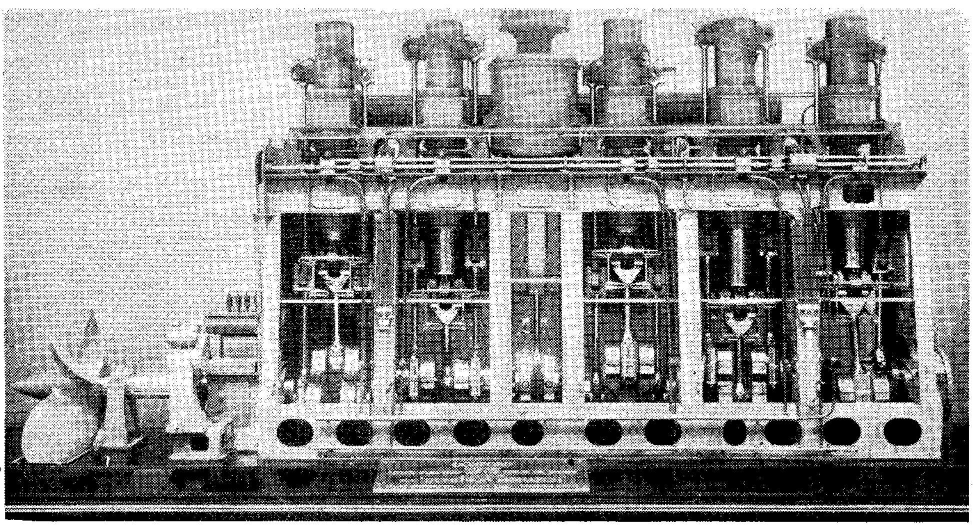


Photo by courtesy of] [*William Doxford and Sons Ltd.*

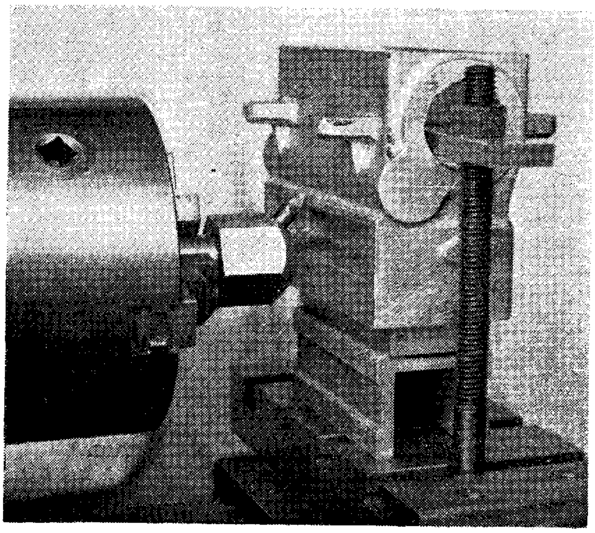
Working model of 5-cyl. 8,000 b.h.p. Doxford opposed piston marine oil engine (one of four built for M.V. "Dominion Monarch")

PETROL ENGINE TOPICS

*A 15-c.c. FOUR-CYLINDER ENGINE

By Edgar T. Westbury

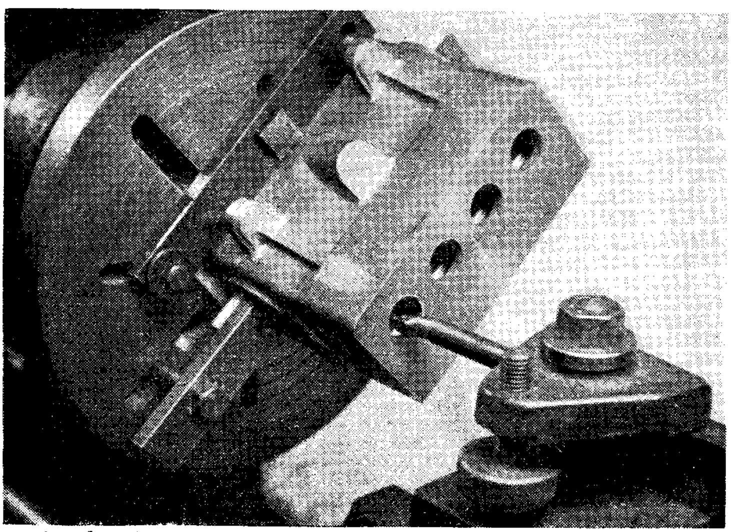
THE flat joint surfaces on the main block and other castings, which form oil, water or gas seals, are intended to be finished eventually by lapping, as this is the simplest way to ensure the smoothness and accuracy necessary to obtain a reliable seal. In machining, however, no pains should be spared to finish these surfaces as smoothly and accurately as possible, to reduce the time and trouble of the lapping operations. Incidentally, one soon finds out faults or inaccuracies in the lathe mandrel or slides as soon as one starts to lap machined surfaces, as the high spots are shown up immediately, and apart from inconsistent errors due to blunt or unsuitable tools, or irregular feed, it indicates the location and nature of the faults in the lathe. One soon finds that there may be, and often is, a great difference between " finish " and accuracy. The form of tool which I have found most suitable for finishing joint surfaces is either a narrow round-nosed tool or an obtuse vee tool with the angle just slightly rounded ; in either case, the edge should be oilstoned to a high finish. As there is a good deal of surfacing work to do on the castings of this engine, it will pay to make a special tool for the job ; it should be kept in keen condition and only used for a light final cut.



Block set up for face-milling valve cover and manifold joint surface

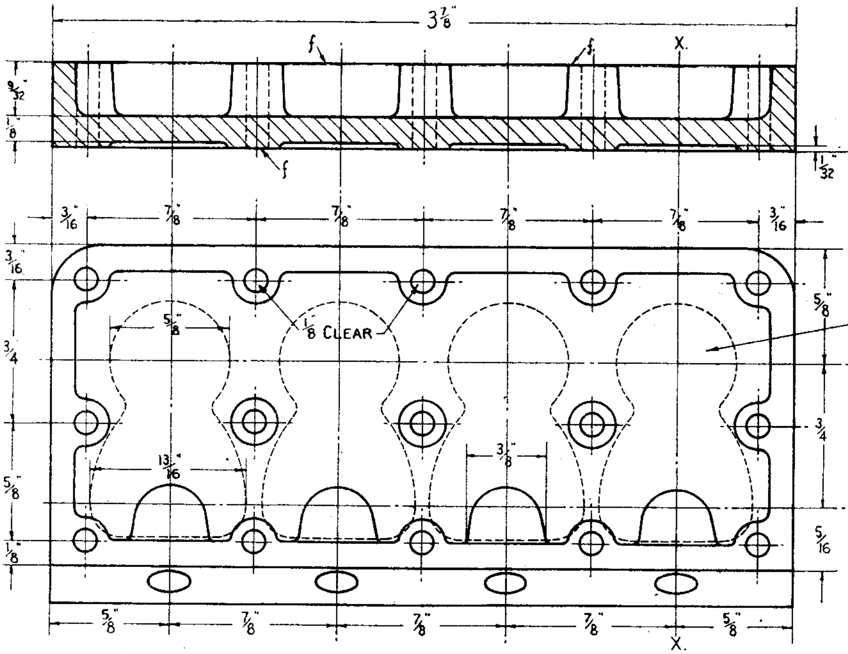
Cylinder-head Block (Fig. 4)

Both the upper and lower surfaces of this casting are joint surfaces, the former being just a low-pressure water joint, while the latter is required to hold cylinder pressure and therefore calls for the most careful fitting. The casting may be held in the four-jaw chuck for machining each surface in turn, care being taken to get them parallel with each other. The inclined side edge in which the sparking plugs are fitted may be machined by clamping the casting to the side of a block of wood planed to an angle of 30 degrees and mounting this on the lathe faceplate. While the head is still attached to the wooden block, the positions of the sparking plugs may be marked off, and each in



Boring the cylinder seatings—note the use of the aligning strip to facilitate re-setting for subsequent bores

*Continued from page 285, "M.E.," March 6, 1947.



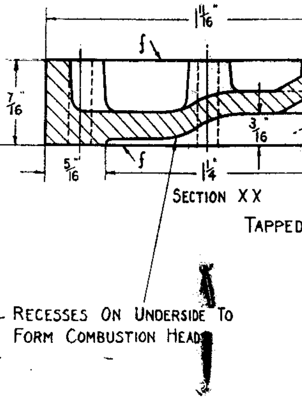


Fig. 4. Cylinder-head bl

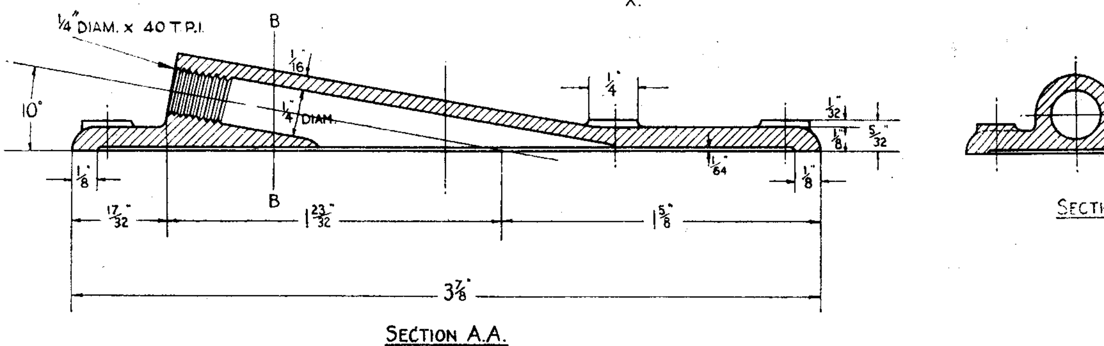
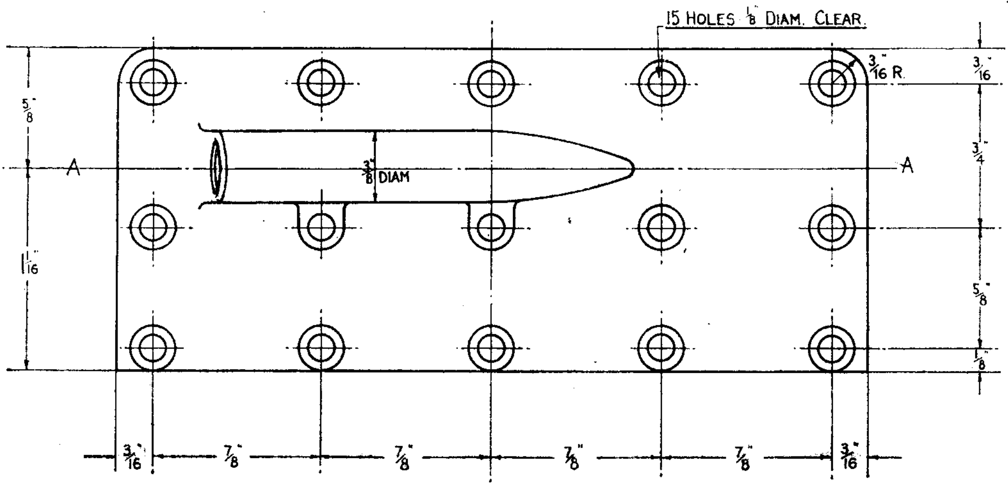
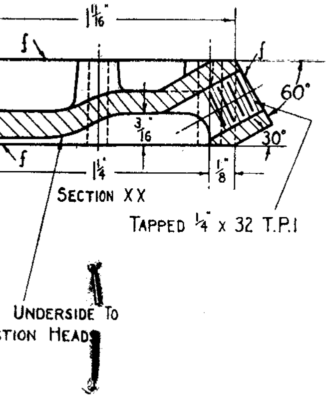


Fig. 5. Cylind cover pl





Cylinder-head block

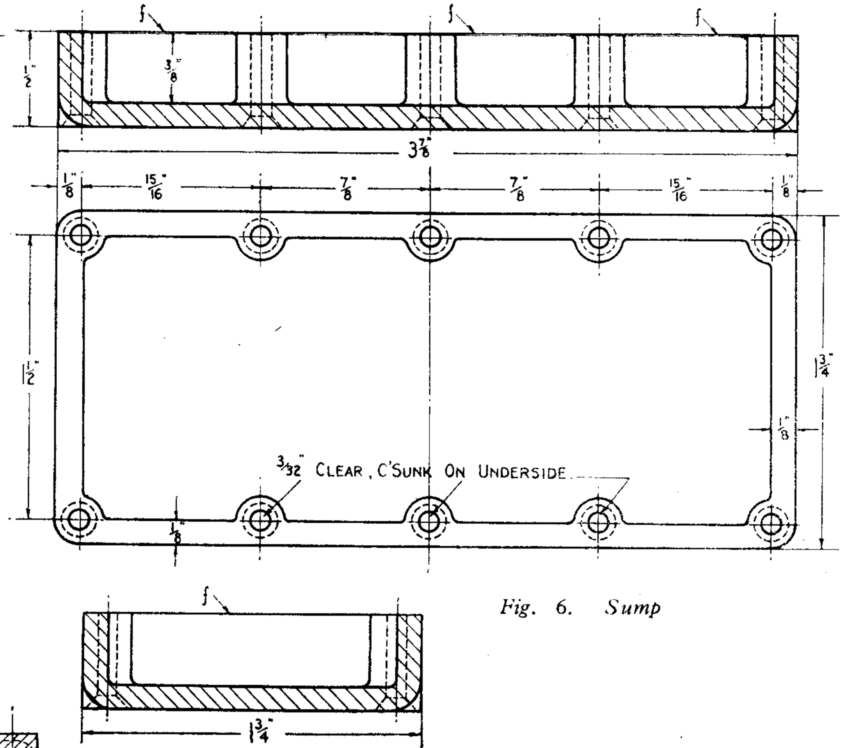
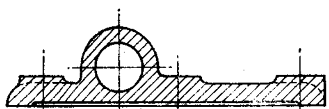


Fig. 6. Sump



SECTION B.B.

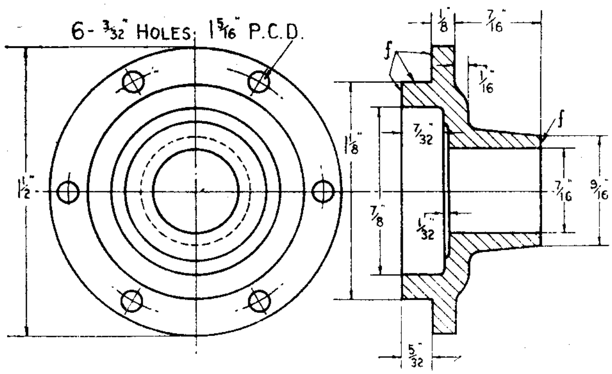


Fig. 8. Main bearing housing

Fig. 5. Cylinder-head cover plate

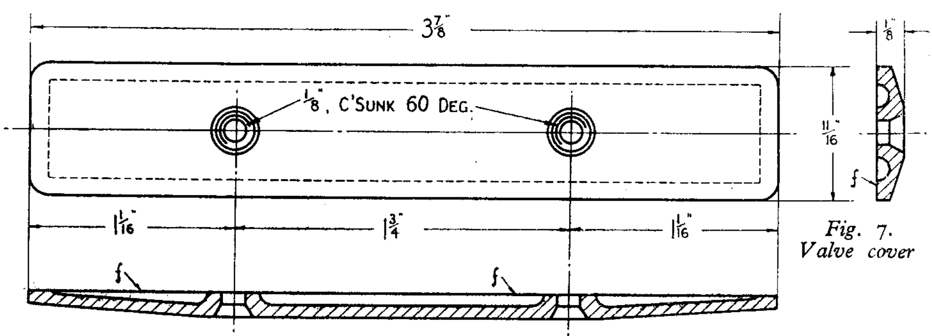


Fig. 7. Valve cover

turn accurately centred on the faceplate for drilling and tapping the holes. This will ensure that the plugs are all at exactly the same angle, and accurately seated when screwed home; it is a much more reliable method than drilling the holes in a drilling machine and facing them with a pin drill.

Cylinder-head Cover Plate (Fig. 5)

This is available with water outlet facing in either direction, to suit engine arrangement, and requires only to be faced on the under surface, which is easily done by holding it in the four-jaw chuck. The hole for the water outlet is drilled at an angle of 10 degrees to this surface (drilling machine methods are quite in order for this) and tapped ¼ in. fine thread, to take an outlet pipe.

In drilling the stud holes in both the cover-plate and the cylinder-head block, it is of paramount importance to see that their location in the latter casting is correct in relation to the combustion head cavities. It will be seen that on the sparking plug side of the casting, there is very little room to spare for the stud holes, and should one of them break out into the cavity, the casting is ruined. For this reason, it is advisable to mark out the positions of the holes very carefully; do not rely on simply centring them from the boss positions in either of the castings. It may not look quite so neat to see a stud hole out of centre with the boss, but it is even more important for the engine to work! However, the castings are sufficiently accurate for both requirements to be fulfilled, so long as the marking-out is done carefully; but one can imagine what *might* happen with castings made carelessly, or from inaccurate patterns.

The best way to mark out the holes is to use a scribing block, resting each casting in turn on a ledge or strip clamped to the side of a heavy vertical block or angle-plate on the surface plate. Mark out the longitudinal lines first, setting the scriber point to the required height, and marking the top side of the cover plate, and *both* sides of the cylinder head at one setting. Shift the scriber to the level of the next row of holes, and repeat the procedure. The cross lines are produced in a similar way, with the casting up-ended, and located by a vertical strip on the angle-plate. In this way, the positions of the holes can be exactly verified, and nothing left to chance. When the main cylinder block is ready for drilling and tapping, the head block may be lightly clamped in place and the holes "spotted" through in position. Either 6-B.A. or 3/32-in. Whit. studs are suitable for securing the cylinder head. Water communication holes are not shown on the detail drawings, but will be dealt with at a later stage in the construction.

Sump (Fig. 6)

Only the upper surface of this is machined, and again, this is a simple chuck operation. The positions of the screw holes may be located from the bosses on the machined face, and after drilling to clearance size for 7-B.A. or 3/32-in. screws, are countersunk on the underside. Use these holes for spotting the positions of the tapping holes in the main block, when the latter are drilled and tapped.

It will be seen from the general arrangement drawing on pages 198 and 199 of the February 6, 1947 issue that an oil trough is fitted inside the sump, being held in place by two countersunk screws through the bottom of the latter. The holes for these screws are not shown in the detail drawing, as it will be found most convenient to mark them out when fitting the trough. A very small machining or filing allowance has been left on the end faces of the sump, as one or other of these will have to be faced to form a seating for either the oil or water circulating pump, if fitted.

Valve Cover (Fig. 7)

This is an optional fitting, as some constructors may prefer to leave the valve springs exposed so that their working is visible, but the enclosure of these parts does help to keep them clean and well lubricated, besides reducing mechanical noise. The cover may be made either from a casting or from sheet metal, and requires only to be faced on the inner side. It is attached by means of two studs fitted to tapped holes in the inner wall of the valve cavity, the holes being shown countersunk at an angle of 60 degrees, to fit knurled nuts having the ends bevelled at a similar angle. This helps to provide a friction lock to deter slackening of the nuts, but, if preferred, ordinary hand or spanner nuts, with spring washers, may be fitted.

Main Bearing Housing (Fig. 8)

A casting is normally provided for this component, but it can quite easily be made from a piece of bar material, of a size large enough to clear up to 1½ in. diameter. The machining is quite straightforward, and should be carried out at one setting, so far as the essential locating surfaces are concerned. Note that the end face of the ball race recess is relieved to prevent fouling of the inner ring. The recess is bored to take a Skefko EE2 single-row ball race, in the fitting of which a plug gauge should be used, if available; but, if not, the race itself may be mounted on the end of a screwed mandrel and used as a gauge. Fit the race so that it will press in lightly, and make certain that it goes right home in the recess; an undercut at the end of the recess is advisable if there is any doubt about this. The spigot of the housing should be a snug push fit in the bore of the main block; note that the housing may be fitted at either end, according to the "hand" of the engine and the direction of rotation. If there should be any possible difference in the diameter of the bores at the two ends, be sure and fit the main housing at the right end.

The nose of the housing is bored to take a steady bush, which may be used as an oil packing labyrinth seal in the event of a forced lubrication system being fitted. This bore must, of course, be perfectly concentric with the ball race. Machining of the outside of the housing is optional, but a skim should be taken over the rim, and also the outer flange face, to form a seating for the screws or nuts holding the housing in position. These may be either 7-B.A. or 3/32-in. Whit.

Neat fitting of the housing spigots in the bore of the main block is essential, in order to avoid taking the piston thrust stresses on the bolts and screws holding the housings.

(*To be continued*)

FOR HAND DRILLERS ONLY

By Stuart H. Rutherford

THOSE of us who have a drilling machine or a lathe are liable to forget that there are many model engineers who are not so fortunate. When we want to drill a hole accurately in a certain direction, we put a drill in the machine chuck and let the machine guide it straight into the job. If we are drilling wheels to fit their axles, we put them into the lathe chuck, run a centre drill in a little way and then follow up with the right size drill, with the assurance hat, if we've done the job with reasonable care, the wheels will fit square on their axles without any wobble.

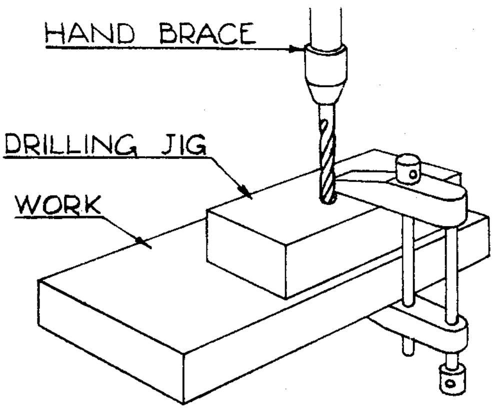


FIG. 2.

But the poor fellow who hasn't got a lathe or a drilling machine is in rather a dilemma if he wants to drill some wheels, because he knows from bitter experience that, however careful he is with the hand drill, even if he manages to get the holes in the middle, his wheels are almost sure to wobble, because it's awfully difficult to hold a drill brace perfectly square with the job.

Like many other things, however, there are ways and means of getting over the difficulty if he's prepared to spend a little time on the job to make up for his lack of equipment. In this age of machines, we are liable to forget that the old craftsmen used to do many operations with precision without the aid of "new-fangled contrivances" like jig borers. Mind you, a jig borer is an indispensable tool in a modern tool room, where they've got to turn work out a little faster than their competitors, but from the point of view of simply getting the job right, irrespective of the time taken, which is what we are usually most concerned with, we can compete very well with the jig borer by using some of the subterfuges of the old tool makers.

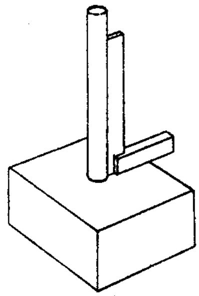


FIG. 1.

Now, getting back to the question in hand. How are we to drill those holes the way we want them without a machine? The obvious answer is to hold the drill true by means of a guide, so that we can't pull it out of true with our brace All very well, you say, but how are we to get our guide? We make it. Yes, but how do we drill the hole in the guide true to start with? Well, we simply don't have to, we can drill the guide hole anyhow, and then, in the words of a friend of mine, "wrap the guide round it." To be more explicit, we get a piece of material suitable for the drill guide or "jig," as it is more properly called, being, according to L.B.S.C.'s "Inspector Meticulous," "a device attached to the work piece for the purpose of truly guiding a cutting tool into contact with the work piece."

Assuming that we ultimately want to drill a hole squarely into a flat face of our job, we drill a hole in our jig of the correct size, or better still a size smaller and ream it out to size, as true to the face of the jig as we can with our hand drill. Now, with the aid of a file or whatever other suitable tools we have available, we proceed to make the surface of the jig truly square with the hole. We can test the squareness of the hole and

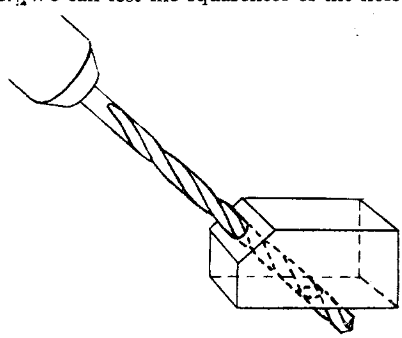


FIG. 3.

the surface by putting a straight rod or drill into the hole and testing with a square as shown in Fig. 1. If our square isn't dead true, it doesn't matter a lot so long as we see that the error is the same all round the rod. Incidentally, it's quite possible to true up a square without any precision equipment, but that's another story. It is necessary to make sure that the surface is flat as well as being square with the hole. Any difficulty that

we may have in producing flat surfaces with a file can to a large extent be overcome by laying the file flat on the bench or clamping it between two pieces of soft metal in the vice and rubbing the jig surface on it, being careful not to allow it to rock. If we want a still better job, we can finish up by rubbing it on a piece of emery cloth laid on a flat surface, preferably a piece of plate glass.

Strictly speaking, of course, the jig should be made of hard steel, so that the drill won't sub-

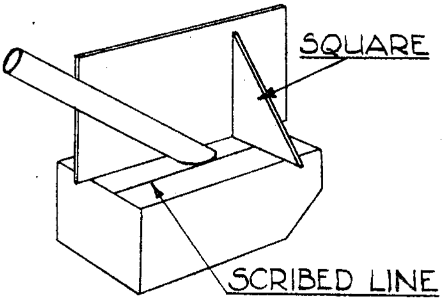


FIG. 4

sequently wear the hole out of truth, but as we aren't likely to want to mass produce holes, a piece of mild steel, or even brass, will do admirably if we take care not to bruise it or let the drill rub it more than we can help.

Now, having "wrapped the material squarely round the hole," we can proceed with our job simply by clamping the jig on to the face of it in the right place, and applying the drill through the jig. It is advisable to apply some lubricant to the drill to reduce its wearing effect on the jig.

If a proper cutting oil isn't available, use machine oil; it's far better than nothing at all, as you will find from the difference in the life of your drills if you've been in the habit of using them dry.

Provided that the hole hasn't to be extremely accurately located on the surface of the job, probably the easiest way to locate the jig is to

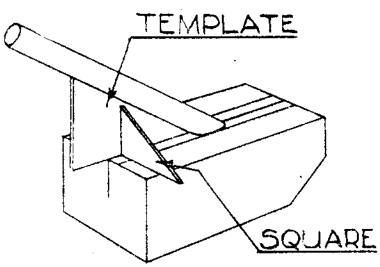


FIG. 5.

centre-pop the job and then drill without the jig until the full diameter of the drill is just starting to cut. Then the jig can be located by mounting it loosely on the surface of the job, pushing the drill through and moving the jig around until the point of the drill enters the dimple that has just been made. The jig is then clamped in position before the drill is removed.

In order to ensure that the drill is adequately supported, the length of the hole in the jig should be at least three times its diameter.

Incidentally, this subterfuge can be used equally effectively on wood, and is very useful for drilling holes in model aeroplane propellers.

The usefulness of jigs of this kind is not confined to drilling holes square into surfaces; in fact, they are even more useful for drilling holes on the skew because they make it possible to start the holes without risk of the drill slipping or drifting, and in the case of holes inclined considerably, it may be impossible to start the drill at all without a jig.

The procedure is similar to that already described, but in order to avoid having to file large lumps off the jig, we first file a flat on one corner as in Fig. 3 and start drilling from there, as nearly as possible at the required angle to the far side of the jig. The side of the jig that the drill breaks out of is then the side that is filed up until it is at the correct angle with the hole.

In order to measure the angle between the hole and the surface, a template is made to the required angle. It is essential that this template is used in the right place. It must be held square with the surface and in line with the rod projecting from the hole. The best way to do this is to place a flat plate of any suitable material edgewise on the surface of the jig and flat up

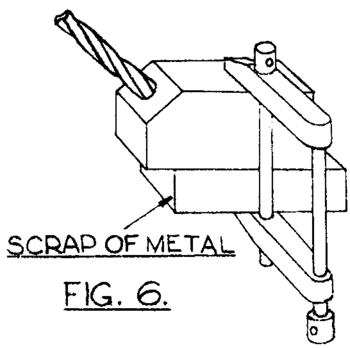


FIG. 6.

against the rod. A set-square is then placed on the surface and against the flat plate, and the plate is turned round the rod until the square rests flat against it, as shown in Fig. 4. Now, without moving the plate, we scribe a line across the surface of the jig, using the plate as a straight edge. We next move the plate round to the other side of the rod and repeat the procedure. If we've been careful enough, we shall now have two parallel lines, and if we remove the rod from the hole and scribe another line midway between them, it will be exactly in line with the centre of the hole. As we shall probably have to file some more off the face of the jig and with it our line, we scribe lines on the end faces of the jig from the ends of our line, so that we can replace it easily, and also to enable us to locate the jig on the job later on.

Now in order to use our template correctly, it must be placed along the line under the rod and square with the surface of the jig as in Fig. 5. All this sounds very complicated, but really it's much easier to do than to describe.

When the drill is breaking out through the face of the jig skew-wise, great care has to be taken to avoid either distorting the hole or breaking the drill. It is necessary to feed the drill in very slowly and avoid putting any more pressure on it than is necessary to keep it just moving forward. If any difficulty is experienced in this respect, it is wise to clamp a scrap of similar material on to the face of the jig as in Fig. 6, so that the drill, as it runs out of the face of the jig, runs into the scrap and is therefore fully supported all the time.

Similarly, when the drill is being started into

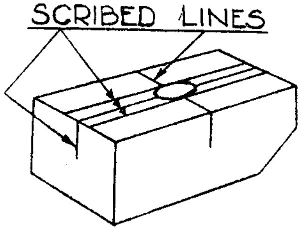


FIG. 7.

the job using the finished jig to guide it, care must be taken to avoid forcing it at all, because it is always liable to be forced into the side of the hole in the jig and thus damage it with the result that the hole in the job will not be true.

When the face of the jig is true to the hole, we scribe another line across it, through the middle of the hole at right-angles to the first line and then scribe marks on the sides of the jig at both ends of the line as in Fig. 7. Now we scribe two lines on our workpiece through the centre of the spot where we want the drill to enter, one line lying along the direction we want the hole to go. The jig is then clamped on to the job with the scribed lines on the job immediately under the marks at the ends of the scribed lines on the jig as in Fig. 8, and we can then carry on drilling. This method should also be used for locating holes that are square with the surfaces if their position is important, as the centre-pop and dimple method

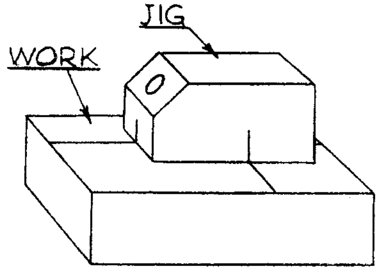


FIG. 8.

depends for its accuracy very much upon the skill of the driller.

These little jigs are very suitable for starting long holes truly, particularly in cases like drilling steam ways from the ends of cylinders into the steam ports, and will considerably reduce the risk of the drill wandering and breaking out into the cylinder bore or through the valve-bearing face.

"L.B.S.C."

(*Continued from page* 334)

happen to know of several engines of this type which were comparative failures when built to the original design; that isn't to say that they did not go at all, but the performance was exceedingly mediocre as compared with what we now expect from an engine of this size and type. As soon as the "Live Steam" notes came out with dimensions of cylinders and valve-gear for engines of similar pattern (not particularly G.W.R., but 4-4-0s in general) the lame ducks were promptly altered, with wonderful improvements. One of them was tried out on my own line, and she certainly did the doings in great style, with a coal-fired boiler, and cylinders and motion as per "words and music."

The original design was good to look at, being practically "to scale," with a faithful reproduction of the characteristics of the full-sized engine; in fact, she was what you might call an artist's design. It was in the works, where the designer slipped up, especially in essential details. I don't remember any mechanical means of feeding the boiler, which incidentally, had a cast back and downcomer (I don't trust castings for boiler work); and no means of lubricating the valves and pistons, was provided at all. The designer said poke the spout of an oil can down the blastpipe and wheel the engine a few turns with the reverse lever in the opposite direction! I guess that is how old man Noah oiled up the donkey engine in the Ark; he didn't know any better. Well we know better now!

Destructive criticism without constructive ditto leads us nowhere, so let's offer a few suggestions once more. As the engine has double frames, they can be left as they are; but the entire original "works" should be what our cousins over the big pond call "canned," and the complete cylinders and motion of the N.E.R. 4-4-0 "750" ("Miss Ten-to-Eight") substituted. That will do the trick right away, as it did in the engine which was tried on my own road. Fit the same engine's mechanical lubricator. For a boiler, look up the one I described for the 3½-in. gauge G.W.R. type 0-6-0 "Iris." This will come in with very little alteration, and the four superheater elements will ensure the steam being well hot and dry, essential for efficient working. The "externals" don't matter, they can be made to the original design, and as many "trimmings" added as the builder desires.

Yes, Curly loves the old-timers; but he likes to see them do the job! If anybody wants to go back farther still, I got out the full specifications for a 3½-in. gauge 2-2-2 "Jenny Lind" of 1847, one of the prettiest of the old-timers that ever ran on rails, and "modernised" her without altering the appearance in the slightest. I will tell anybody where they can get the full set of blueprints if they write me, and enclose a "return ticket."

AN ADJUSTABLE CUTTER HEAD

By R. L. Sweatman

THE tool described in this article is an adaptation of the flat steady box tool commonly used on capstan lathes and was originally made to facilitate the making of a large number of special shouldered pins of small diameter, which would have been very difficult to make by ordinary turning methods.

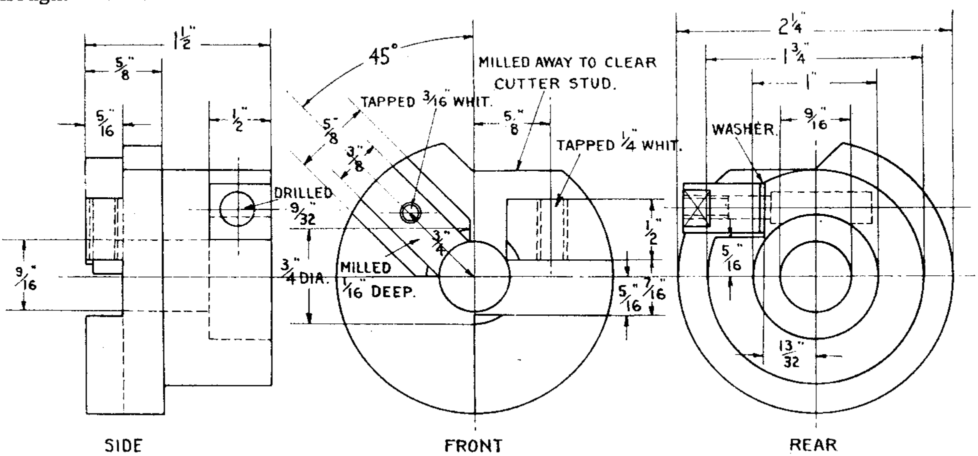
In its original form, the tool was made to clamp on the tailstock barrel, being held in place by means of a cotter and nut, but the general construction is such that allows of easy modification to suit other requirements, and might quite easily be adapted for Morse taper fitting.

No special castings are required to construct the tool, the original being made from the fuse plug of an Ack-Ack shell, and, as described below, is made from the solid bar.

The whole may be made in a very short time, and will soon repay the time spent, and, at the same time, making an otherwise difficult job quite easy.

The Body

The body is machined from a solid piece of brass or bronze (cast iron may be used if desired), $2\frac{1}{4}$ in. diameter by $1\frac{1}{2}$ in. long, finished size. Chuck in the three-jaw, and face the end. Turn down to $1\frac{3}{4}$ in. diameter for $\frac{7}{8}$ in. Bore $\frac{9}{16}$ in. right through. Counter-bore to fit tailstock barrel.



Details of body

(*Note.* If T's barrel is over 1 in. diameter, the diameter of the reduced portion at the rear end must be modified accordingly.)

Reverse in the chuck. Face front end, and skim up outside diameter—$2\frac{1}{4}$ in. Counterbore $\frac{13}{16}$ in. diameter 3/32 in. deep.

The next step is the milling out of the cutter seating, steady seating, and the clearance for the escape of swarf, all of which is performed by means of end-milling. The method of setting up for this process will depend upon the means available, but the original was done on a wooden block, which was packed up to suit the various cuts, no trouble being experienced throughout. For milling on the face of the body, a hole was bored in the block, and the body held by the reduced portion and turned as required.

The cutter seating must be exactly $\frac{5}{16}$ in. below the horizontal centre line, and the vertical face of the cutter seating must be exactly on the vertical centre line, to facilitate cutter setting, as will be explained later.

The whole of the milling on the face of the tool, with the exception of the steady seating, which is $\frac{1}{16}$ in. deep, is carried to a depth of $\frac{5}{16}$ in. The seating for the steady must also be at 45 degrees to the vertical centre line, as shown on the drawing.

After milling out the clearance, the remaining flange is milled away as shown, to allow room to turn the cutter clamping stud.

The body is reversed on the fixture, and the seating for the cotter nut end-milled out. The corner shown as square in the side elevation on the drawing will be better left radiused from the end mill.

The next stage is the drilling and tapping of the various holes. Of these, only the cotter hole may present any difficulty, and is best carried out as follows. Make a plug to fit the hole in the rear of the body. Place in position, and drill the cotter hole. The use of the plug will prevent the drill running out of line, and will leave a nicely-finished hole.

If a Morse taper shank is fitted, it will be fitted direct into the end of the body, and a cotter will then be unnecessary.

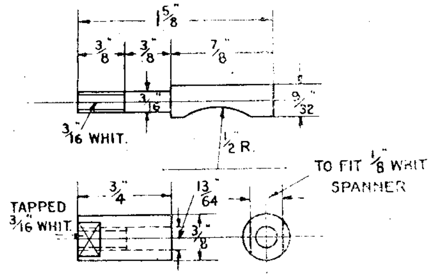
The Cotter and Nut

The cotter is a plain turning job, from 9/32-in. silver steel, left soft. The dimensions are shown on the drawing, the radius for the T-S. barrel being best turned out with the cotter in position in the body, fixed temporarily for the purpose, the body being held in the three-jaw chuck.

The nut is made from $\frac{3}{8}$-in. silver steel, and is tapped $\frac{3}{16}$ in. Whit. half-way, the remaining half being drilled 13/64 in. to clear the shank of the cotter. Two flats are filed to fit a $\frac{1}{8}$-in. Whit. spanner.

The Steadies

The steadies are made in two halves, to facilitate their adjustment on the work. They are made from steel, and are hardened after fitting. The working faces must bear a high polish if marking of the work is to be avoided, and all sharp corners must be removed for the same reason.



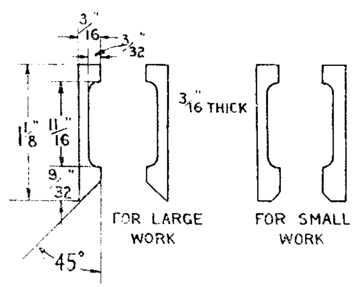
Clamping cutter and nut

It is advisable to make two sets of steadies, as shown, for large and small work.

The Cutters

The cutters are made from $\frac{5}{16}$-in. square steel, and are given clearance in all directions, in a similar manner to a knife tool. The cutting angle must be ground to suit the material to be worked upon, and it will save time if several cutters are made to cover the different types of work to be carried out.

It will be fairly obvious to readers that countersunk headed screws may be made with this tool, simply by making a cutter which will leave a shoulder on the work-piece at a suitable angle, while any special form of head may be made by the same means.



Vee steadies. Cutter clamping stud, $\frac{1}{4}$-in. Whit., $\frac{7}{8}$ in. long. Steady clamping stud $\frac{3}{16}$-in. Whit., $\frac{5}{8}$-in. long

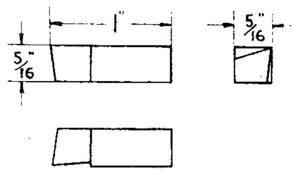
The clearance on the front of the cutters must be kept as small as will work freely—about 3 degrees is sufficient. The cutting edge must also be exactly on the horizontal centre line, especially for small work.

Using the Tool

The tool is placed on the tailstock barrel, and clamped in position. The work is held in a suitable chuck, and the tool advanced so that the work-piece is just engaging the steady. The steady is adjusted to rest firmly on the work-piece and clamped firmly in place.

The cutter is then set to cut to the required size. This may be done roughly before the tool is placed on the T-S. barrel by measuring *half* the required size from the vertical face of the cutter seating to the tip of the cutter.

The tool must be fed up slowly and evenly, and



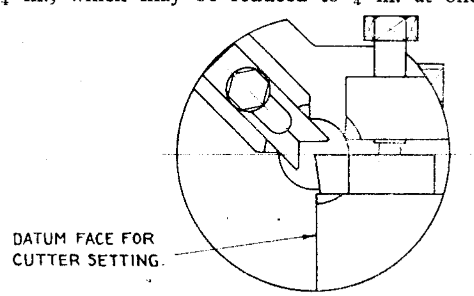
Cutter for steel

after about $\frac{1}{8}$ in. has been run, a check of the diameter of the work should be made, and any re-adjustments made. With a little practice, the cutter can be set very closely to size, and the final sizing can be very precise.

Conclusion

Several improvements will be obvious to readers, among which will be the provision of screw adjustment to the cutter. This was fitted to the original, but was found to be a doubtful advantage, and was discarded after a short while. It has been omitted from the present form for the sake of simplicity.

The range of the cutter is considerable. The largest stock which may be operated upon is $\frac{3}{4}$ in., which may be reduced to $\frac{1}{4}$ in. at one



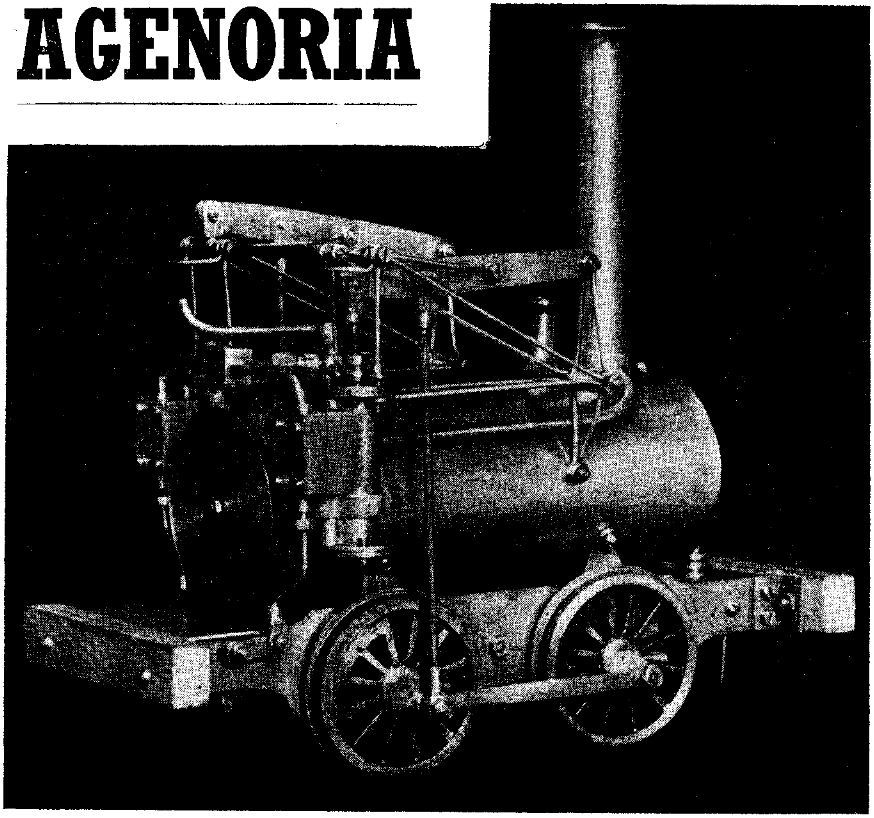
Front view of assembled cutter head

traverse, and the largest diameter at which the work-piece may be left is $\frac{9}{16}$ in. All sizes up to these limits may be cut with ease, and double-shouldered jobs may be done by taking a second cut.

Fitted to a capstan head, together with a die-holder, small screws may be produced with the greatest facility.

The length of work produced is only limited by the travel of the tailstock screw, and if a Morse taper shank is fitted, it is a good plan to drill up the shank to allow the work to clear behind the tool.

AGENORIA



By B. Jefferies

In bygone days, when railway trains were few and lumbering stage coach plied from town to town, when locomotives were, to most folk, new, came "Agenoria"

From Stourbridge town in Worcestershire, she came where, in the glow of forge and furnace bright, an engineering firm of widespread fame built "Agenoria"

'Twixt grim Shutt End, whose furnaces aflame lit up the neighbourhood around at night, and fair Greensforge, where many barges came, toiled "Agenoria."

Then travelling by rail was at its dawn and people flocked in multitudes to see a train of loaded wagons slowly drawn by "Agenoria."

And when they saw the engine's plunging beams and clouds of steam from belching chimney stack, such wonders were beyond their wildest dreams of "Agenoria."

But some who came, the strange machine to see, were filled with fear and could not but believe some hidden evil spirit there must be in "Agenoria." Indeed, "Old Harry's coming" they exclaimed when trains approached them on the Shutt End line, but "Grasshopper" most local people named old "Agenoria."

For five and thirty years she toiled away, her trains of loaded coal trucks daily drawn, and many engine drivers of that day knew "Agenoria." But there was one, a genial cove, a man of many years and well beloved, with glossy curls that fluttered as he drove old "Agenoria."

His kindliness he did not seek to hide. He had a cheery word for all he knew, and sometimes favoured children with a ride on "Agenoria," My mother spent her childhood in that part. She knew that picturesque old driver well, and always had a soft place in her heart for "Agenoria" for ofttimes she related with a smile how once beside that driver she had stood and travelled for a fraction of a mile on "Agenoria."

But came the day when in the railway race for speed and progress o'er the countryside a much more powerful engine took the place of "Agenoria." Her day and generation now were past. Through all those busy years she served them well. 'Twas fitting that a home was found at last for "Agenoria."

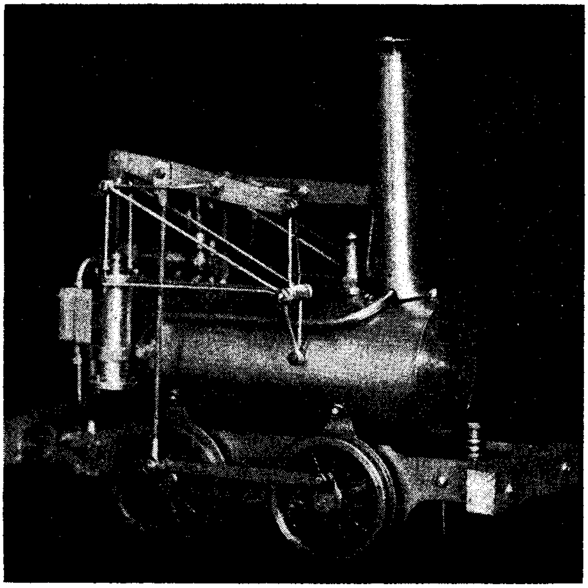
So now at Kensington in London town, where many famous engines lie at rest, with other locomotives of renown stands "Agenoria." She stands amid the railway champions there—the

"Rocket" and old "Puffing Billy" too—but none that honour more deserved to share than "Agenoria."

Attraction

So runs the story of "Agenoria." In my childhood I was as interested in trains and railways as present day boys are in motor cars and aircraft, and what I heard from my parents about the strange old engine attracted me. My father had a booklet containing a sketch of "Agenoria," and when quite young I made an enlarged drawing from the sketch and framed it. I still have the picture.

My mother's father worked at Shutt End and lived at Greensforge—a good four miles walk morning and evening, country miles too. It is possible that his nearest way to work was along the railway track, but it is hardly likely that he ever had a lift on "Agenoria," for when he was on his way she would be in the shed, in those good old days when 6 a.m. to 6 p.m. constituted a day's work. I can vividly recall visiting my Grandad who, although turned 70, still carried on in employment on the Shutt End line. The engine then in use was one of the Earl of Dudley's saddle tanks, and the track had evidently borne many heavy loads during many years, for not being of steel the rails were much frayed at the edges.



Possibly "Agenoria," barging along with uplifted threatening beams, had travelled on those same rails less than 20 years previously.

Tinkering

My early attempts at model engineering did not get far beyond wire and tin contraptions for I was preparing for a scholastic career, and "the powers that be" at that time looked upon such "tinkering" as mere waste of time. But in later years, thanks to help and encouragement from THE MODEL ENGINEER, and a sympathetic wife, I have built a number of stationary engines and two locomotives, which, while by no means engineering masterpieces, supply the satisfaction of "something attempted, something done."

With the advance of years one's thoughts turn with affection to early associations, and during the recent war I felt an urge to bring the old picture of "Agenoria" to life in a model that looked and worked something like the prototype. I have a photograph of the old veteran and have seen it in the Science Museum, but not having then any desire to build a model of it I had not noticed details of its construction so the model had to be very largely free-lance.

A Missing Cylinder

Possibly if I had examined the original I should have been disappointed, for it is on record that when it was decided to send the engine to South Kensington one of its cylinders was missing, and was subsequently found in use as a pump in a local colliery. Goodness knows what else was missing.

The model is to $2\frac{1}{2}$-in. gauge. Only the leading wheels are sprung, as in prototype, to avoid dancing effect of vertical motion. The boiler is of copper within a casing of brass. There is one longitudinal water tube and the boiler is heated by a spirit lamp with two wicks.

The cylinders are built-up, half-inch bore and one-inch stroke. For appearances' sake they are longer than necessary, so the pistons are thickened accordingly.

Slip eccentric gear is used as, I believe, in the prototype, for in a description I have of the engine, it is stated that the motion was by single eccentric and of a primitive nature. The chimney is shorter than scale length and, I think, looks more pleasing. The beams are of German silver, and I found bicycle spokes very suitable for the framework of rods which give the engine its "grasshopper" feature. By the way, I found that as interesting and ingenious as Watt's parallel motion.

The model is not very powerful, but then, if it could travel quickly so that its motion appeared as a blur it would by no means be true to the prototype, the maximum speed of which was little more than 12 m.p.h.

When I recall that "Agenoria" worked for 35 years, I think it reflects considerable credit on its builders Foster, Rastrick & Co., who built a similar engine called the "Stourbridge Lion," that went to America in 1829. I expect it would be difficult to find a motor car whose engine could work for 35 years, but then, the car engine, like its driver nowadays, lives such a hectic life, and probably revs. many more times in one year than "Agenoria" did during her whole career.

ELECTRIFYING
A MODEL RAILWAY

WHEN I first broached the subject of electrifying a portion of my railway, many of my friends flung up their hands in horror and pitied me for taking such a retrogade step! But when I explained that it was only going to be a portion of my line, and that I was converting my battery locomotive and the Southern train from batteries to an outside source of power, they breathed a sigh of relief.

The battery locomotive and the Southern train owed their origin to finding a simple method of running a train for the benefit of the "nosey-parker" type of visitors. Before the war, people used to ring the door bell and ask to see the railway. Being willing to oblige, I trotted out and, at their request, got up steam on an engine and gave a demonstration. Times out of number, the train would do two or three laps and then, as they had seen all they wanted to see, they would thank me and depart. I decided, therefore, to get something electric which would give a performance for that kind of visitor and save me a lot of trouble and work, and at the same time would give me the opportunity of discriminating between the "nosey-parker" and the real enthusiast. I always welcome the enthusiast. In him one meets a kindred spirit and one also has the opportunity of exchanging ideas. I must admit that, at the time these battery units were produced, I had the idea that one day I would convert them to correct electric propulsion. I have always been an admirer of the big Continental electric engines and trains. Although they are not so fascinating or interesting as the steam locomotives, they seem to radiate power and majesty.

A year or two before the war, a Swiss enthusiast came to visit me. During the afternoon I broached the subject and he gave me much useful information, and told me that he, himself, had an outdoor electric line on the overhead system, which was a complete success. When he returned home he sent me some very interesting photographs, showing a most complicated layout which looked like a miniature Gothard Railway, with its tunnels and viaducts. The war put paid to all my railway work, with the exception of introducing the Courtice Control system, in 1945. Also there was, and still is, heaps to be done on the line to bring it back to its pre-war standard. Therefore, it was not until the autumn of 1945, when I was forced to stay at home and rest, after an operation, that my thoughts once again turned to the possibility of electrifying a portion of my line. I then went through all the literature I could lay my hands on regarding electric traction. I decided finally that the overhead system was the best for an outdoor model railway, except in my Central station. I did not like the idea of the overhead wires there, as I felt sure they would be in the way and be easily damaged. I decided that in the station I would employ the third-rail system, as used on the Southern Railway. This meant collecting shoes as well as pantographs. As I could not do anything very strenuous at this time, I thought I would get busy constructing a pantograph.

The only information I could find on that subject was in Henry Greenly's book, "Model Electric Railways." In it there was quite a good design which turned out not to be exactly ideal. To make it work I introduced cross-stays and also fixed a proper bow with horns. The snag then was how to keep the bow upright. All the photographs of pantographs I looked at did not show this detail clearly. I mentioned my troubles to Mr. Bassett-Lowke, and he kindly put me in touch with Mr. Siegwart, the president of the Swiss Model Railway Club, who sent me a most charming reply, informing me that the Club's technical adviser would reply in detail. Mr. von Speyr sent me, in due course, detailed sketches of the type of pantograph they used on their "O" gauge railways. These solved the problem of keeping the bow upright. Also at that time I had the pleasure of meeting Mr. Ker, of the L.N.E.R., and poured out my trouble to him on the subject. The next day detailed drawings and a close-up photograph of a pantograph arrived. Although they looked a bit more complicated to construct, it was easy to see that they would work perfectly. I regretted then that I had not waited until I had received these designs, but at the time I was itching to get busy on something to pass the time. Anyway, these Greenly pantographs

A NOVEL EXPERIMENT
By VICTOR B. HARRISON

collected the current all right, but they required a fearful lot of adjustment. I first converted the electric locomotive. This was not very difficult, as it was just a case or re-wiring and making pantographs and collecting shoes. The latter gave me quite a headache, as the brass strip I used for them seemed to lose its springyness after a time.

Mr. Phillips, of Messrs. Bonds, suggested using phosphor-bronze strip for the purpose. He managed to find a piece of the right width and thickness. The shoes now are perfect. They can clearly be seen in the photograph of the engine. In the test of the locomotive on a short piece of track indoors, combining both third rail and overhead system, everything worked perfectly. When it came to installing the system on the site I very nearly met my Waterloo. Those of your readers who know my railway, or have seen photographs of it, will remember that to enter the railway shed the trains have to go through short tunnels, and in order to pass through them the pantographs had to be collapsed. My first idea was that a fixture could be fitted to collapse them, but unfortunately there are shutters to these tunnels to keep birds and cats out of the shed when not in use. My younger son tried all sorts of schemes, but they all proved unworkable in practice. Not even our combined brains could find a solution.

my son re-wound, and they worked perfectly.

I had by me two solenoids that I had used in my experiments with the wireless control of my "Mauretania," which were wound for a 12-volt circuit. These solenoids would give a pull of about 1 in., but as a pull of $1\frac{3}{4}$ in. was required, my son got to work and arranged pulleys as shown in Fig. I., which gave a pull of nearly 2 in. The next trouble was what kind of cord to use to work the whole apparatus. My son was in favour of using some fine copper flex wire that I had bought years ago to use as signal wire. This did not stand up to the job at all. It kept on breaking. We finally decided to use some thin fishing cord. This was carefully whipped on to the adjusting screw and the hook that connects it with the bow of the pantograph. This works well and shows no sign of deterioration. The solenoids require about 8 volts to make them work, but only about 2 volts to keep the pantograph down. This is mainly due to my son inserting a mild-steel plug in the end of the solenoid. This acts as an additional magnet, and so the armature remains in the solenoid.

Fig. 2. shows how the whole scheme is wired up in the Southern train. and the Swiss locomotive. Both the Swiss locomotive and the Southern train can still be controlled by their reversers and resistances. This enables one to

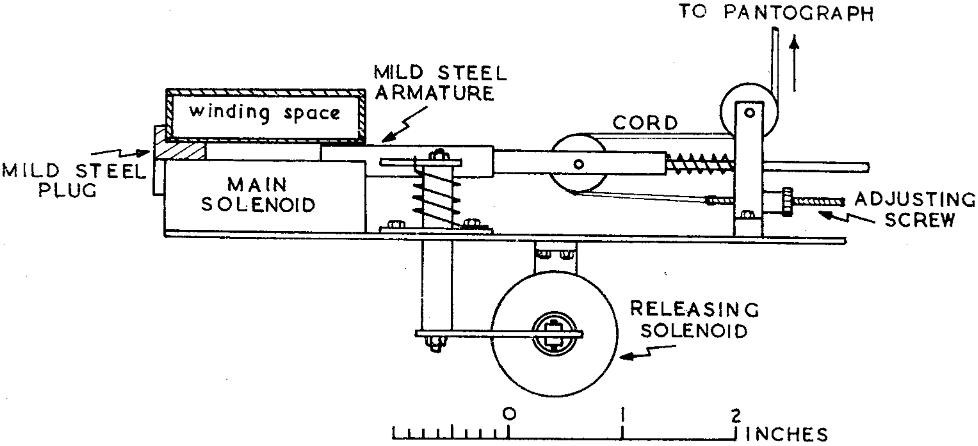


Fig. I. PANTOGRAPH RETRACTING MECHANISM

I mentioned my troubles to my elder son on an occasion when we met, and without hesitation, he said, "Why not fix up a solenoid to pull down the pantograph when the shoes engage with the third rail?" I told my younger son about it, and his reply was that it was easier said than done. Nevertheless, he got to work on it, and decided that a relay would have to be introduced in the circuit so that the solenoids only worked when the shoes came in contact with the third rail, and remained inoperative when the pantographs picked up from the overhead line.

The next item was to get hold of the suitable relays. He called on the local garage proprietors, who produced two suitable car cut-outs, which

stop either of them when one is away from the controller in the shed. Also it enables one to cut out either of them while the other is in use.

When discussing the overhead system with my Swiss visitor, before the war, he recommended using $\frac{1}{16}$-in. $\times$ $\frac{1}{8}$-in. brass strip instead of wire, as it was stiffer than copper wire, and also was easier to suspend. I forgot exactly how he did it, but my method is as follows :—

First of all the problem was how to make easily-constructed posts and cross-members. In my material rack I found a length of $\frac{1}{4}$-in. brass tube, $\frac{1}{8}$-in. bore. I found that on one portion of the track I would require 9-in. posts. I cut off two 9-in. lengths of this tube and trued up

both ends. Half-an-inch from one end I drilled through an $\frac{1}{8}$-in. hole in order to be able to insert a piece of $\frac{1}{8}$-in. brass rod as a cross-member, for carrying the brass strip. The half-inch between the hole and the end of the tube was threaded inside, 5/32-in. × 40 threads per in. A finial to the post was made with a 5/32-in. shank, also 5/32 in. × 40 threads per in. This enabled one to use the finial as a sort of grub screw to lock the cross-member into the post. The $\frac{1}{8}$-in. bore of the tube was just right for this operation. Two suitable bases were made up for the posts. A piece of $\frac{1}{8}$-in. round rod was cut off to a suitable length for the cross-member, and in the centre a $\frac{1}{16}$-in. hole was drilled.

The next item was a forked joint drilled 3/64 in. through the fork with $\frac{3}{4}$-in. × $\frac{1}{16}$-in. shank. This was made all in one piece. The shank was threaded $\frac{1}{16}$-in. Whitworth and inserted in the $\frac{1}{8}$-in. rod with a nut on either side. This made it possible to adjust the height of the strip carried by the fork above the rail. The strip was drilled with a $\frac{1}{16}$-in. hole, and, when inserted in the fork, it was held in place by a 3/64-in. copper rivet. The rivet was cut off short and closed by means of a pair of parallel pliers. The 3/64-in. rivet in the $\frac{1}{16}$-in. hole gives a little play for expansion of the strip.

For my tests I rigged up a two foot length of the overhead system. I was delighted with its appearance and also this method of construction was fairly easy and straightforward.

One of the original bases was used as a pattern for castings. These, when received from the foundry, were very clean indeed, and only required boring to receive the tube for the uprights. My son and I then came to the conclusion that an outdoor test must be made. The weather was all against us, but, nevertheless, we managed to lay some third rail, both inside and outside the railway shed. Sufficient third rail had to be laid outside the shed to accommodate, if necessary, a four-coach Southern train. This train has a motor at either end and a pantograph and shoes have been attached to the two motor coaches. This length of third rail had to be done so as to be quite sure that when the train left the overhead system and was travelling at speed, there would be plenty of time for the pantographs to collapse before entering the tunnel. There was one bad feature about laying the third rail on the outside portion of the track. The third rail chairs came very close to the rail chairs and, therefore, there would be a definite leak of current between the two on damp days. On discussing this with Mr. Crebbin, who also was interested in this venture, he suggested that I should use some sleepers made of vulcanite, or other non-conducting material, and lay them between the other sleepers, and on to this fasten the third rail chairs. It was a very good suggestion, and although it was a job to cut the vulcanite sleepers, and then drill and tap them to take 12-B.A. screws to fasten down the third rail chairs, it was well worth while.

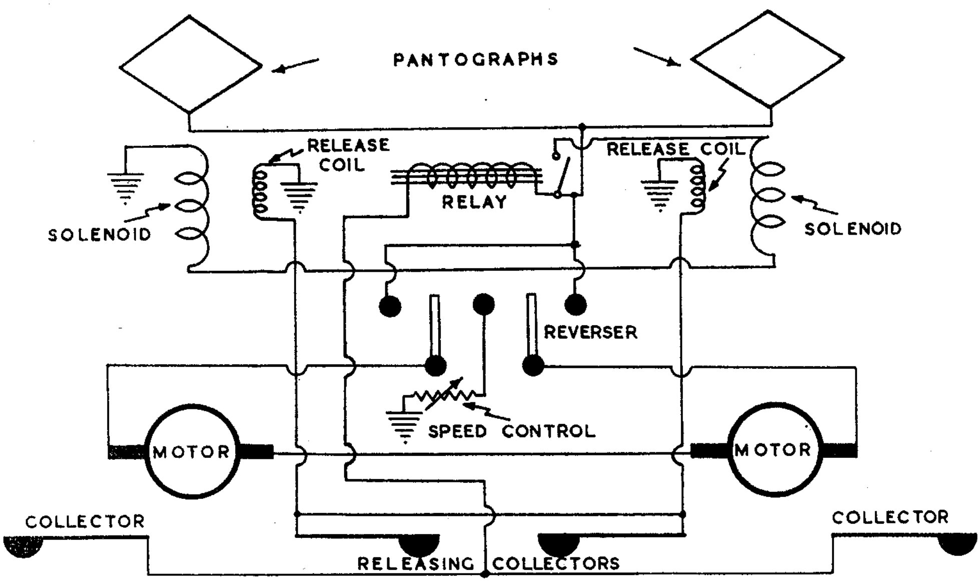


Fig. 2. LOCO WIRING DIAGRAM

By persevering during the Christmas holidays we had got 12 ft. of third rail laid on the outdoor portion, and 18 ft. of overhead line set up. In addition, sufficient third rail laid inside the shed.

As we were starting the electrification on the branch line another complication arose. The branch line passes the door of the shed across a lifting bridge, so therefore the electric circuit was broken. It was necessary to lay two feeders, one for the outside portion and one for the inside, or station, side, plus flexible couplings for the lift bridge. My son made an excellent job of it.

During the holidays my son constructed the reversing controller, and also a special panel for a cut-out and fuse-box to control all circuits. This scheme for the construction is as follows :—

The first item to be considered was a suitable overload release. This was found in a 6-volt Lucas car cut-out, and is arranged as shown in the diagram, see Fig. 3. The cut-out consists essentially of an ordinary "make" relay, with a double wound coil. One winding consists of a few turns of thick wire, about 16 s.w.g., and the other having a large number of turns of finer wire, about 30 s.w.g., the former being the "current" coil, the latter the "hold" coil. When the main switch is switched on, and the re-set button depressed, a circuit is completed through the resistance, the red and green lamps, and the "hold" coil itself. This closes the cut-out contacts, short circuiting the green lamp and the re-set button, as a result of which the contacts remain closed after the re-set button has been released.

Now, when current is drawn off to a locomotive, it all passes through the "current" coil of the cut-out, in such a direction as tends to de-magnetise the iron in the cut-out. When the current becomes excessive, say, due to a short circuit on the track, the magnetic effect produced by the "hold" coil is completely neutralised by that of the "current" coil, and the contacts fly apart, thus rendering the whole apparatus dead. This is arranged to take place at a current of about 7 amps. through the "current" coil. If it is attempted to re-set the apparatus before removing the short circuit, on depressing the re-set button, the red warning lamp will light up, and, depending on the magnitude of the short circuit, the cut-out contacts will come together, causing an excess current to flow, which will make them fly apart again, and so repeating the process many times per second, producing a high pitched warning buzz, thus indicating that the short circuit has not been removed.

When the apparatus is set, and is functioning normally the green lamp is alight. The resistance in series with the green lamp and the "hold" coil was necessary because the "hold" coil winding was intended for only 6 volts ; the value of the resistance is of the order 50 to 100 ohms, depending on the value of the current at which it is desired to cut out ; increasing the resistance lowers the limiting current, and vice-versa. The supply voltage is 30, which is found sufficient to overcome any trouble due to dirt on the track.

The controller itself is of no special interest, except for one small feature. It is of the normal type, being simply a variable resistance and reversing switch combined. The handle swings 90 degrees either side of the off position, one side giving forward speeds, the other reverse speeds. There are six speeds, which is found to be sufficient for smooth running, though it is about the minimum. Incorporated in the controller is a push button which, when depressed, short circuits all the resistances, supplying full voltage to the train, the reason being as follows ; it is usually desirable to approach the tunnel entrances to the stations at something a good deal less than full speed, especially at one part of the line where there is a down grade to the station. Shortly before reaching the tunnel entrance, the pantographs leave the overhead wire, and the shoes at rail level commence to pick up the current from the third rail and supply it to the motors, and the pantograph retracting solenoids. The solenoids, however, require full voltage to work them. So the button is depressed momentarily, supplying full voltage for just long enough to pull down the pantographs, not long enough to cause any appreciable alteration in the speed of the train. Once the pantographs are down, the armature of the solenoid (Fig. 1), is in contact with the mild-steel plug and will remain there even if there is only a very small current in the solenoid.

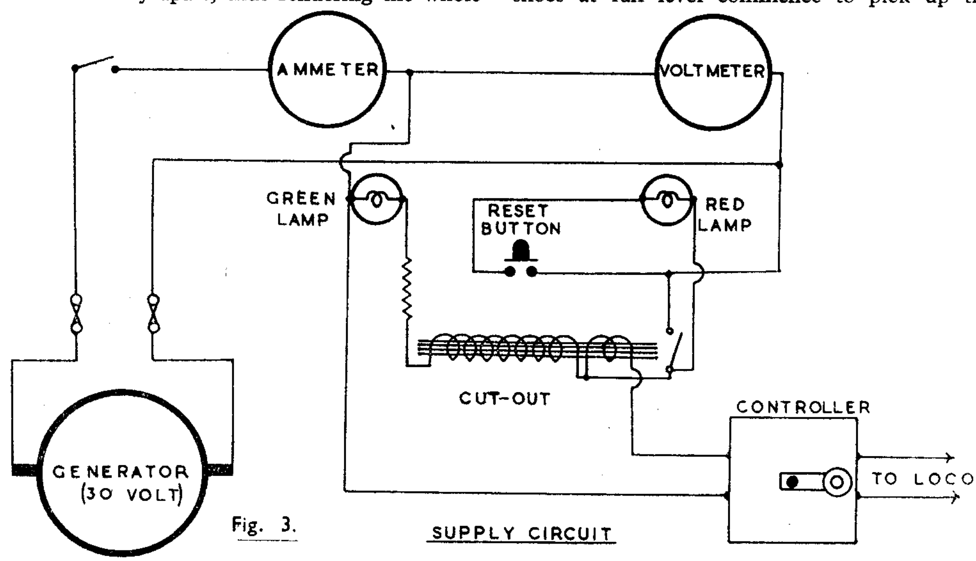


Fig. 3. SUPPLY CIRCUIT

(*To be continued*)

Letters

Cutting Square Threads

DEAR SIR,—As one of a family team of amateur modellers and light experimental engineers, my province is the making and improvement of our workshop machines and equipment, and I am faced with a difficulty which must be common to a large section of our readers, viz. : the successful cutting of internal square threads for screws $\frac{1}{2}$ in. diameter and smaller.

Apart from the difficulty of mounting cumbersome pieces in the average lathe, the small core diameter precludes the use of a rigid overhung tool, and chatter and breakages seem to be the usual end of attempts by this method.

Square-thread taps are not in ready supply, and are very expensive, 50s. to 60s. for a set of three for a $\frac{3}{8}$-in. diameter screw, which is quite out of the question when only one or two holes may be involved.

Home-made taps of this type are a much more difficult proposition than 40 t.p.i., and the like, and owing to the large cutting and frictional areas and the small core diameter, must be very carefully heat-treated to avoid twisting through softness, or breakage from excessive hardness.

I feel that this is a most suitable subject for some of our amateur experts to discuss, and I am sure those who have solved the problem would be glad to share their experiences.

My own idea is that the happy solution lies in some form of boring bar, held in the slide-rest, and slideably supported behind the work piece in a bush in the nose of the hollow spindle.

This would carry a single adjustable cutter, and be fed by the lead screw in the usual manner.

This presents a pretty problem, as the cutter would need to be interchangeable to permit of 8-10 and 12 threads to be cut on the diameter for which it is designed, and would need to have fine and firm adjustment for depth of cut.

The idea is not a "production" tool, but a device which would meet the varying needs of one or two odd jobs in the course of the year, without excessive expense.

Yours faithfully,

Sheffield. "PLANT and MAINTENANCE."

Designs in the "M.E."

DEAR SIR,—May I be permitted to reply to Mr. K. N. Harris's remarks in THE MODEL ENGINEER of January 16th, 1947. I do consider it a slur upon our journal and upon our present designers to say there were more first-class designs prior to 1920. Referring to locomotive practice, our friend "L.B.S.C." has designed and built locomotives which look good and, what is more important in any design, they do what they were designed to do. "L.B.S.C.'s" designs have been responsible for hundreds of small locomotives doing a real job of work, an achievement which prior to 1922 was practicallly unknown in gauges less than the $7\frac{1}{4}$-in. "Garden Railway." Then again, there is Mr. E. Westbury, whose I.C. engines no one can criticise. Mr Westbury's designs are not only first-class, but do what their clever designer intended. To mention a few, his Road Roller, "1831," in $3\frac{1}{2}$-in. gauge, fabricated two-strokes and many more. These are only two of our leading designers in the model world, and if Mr. K. N. Harris read THE MODEL ENGINEER from cover to cover every week he would soon find no shortage of first-class designs. Once again I would remind Mr. Harris that "L.B.S.C.," Mr. E. T. Westbury, Mr. J. C. Crebbin and our other friends and designers have always moved with the times and to us, the humble followers, this is to our advantage. One has only to visit our MODEL ENGINEER Exhibitions to hear the remark, "The standard gets better every year." Surely without first-class design our models would have a very bad start. May I in all humility suggest, having read quite a lot of Mr. K. N. Harris's articles, that he leads the way by designing and building something original, which will not only be first-class, but really work and give the same pleasure which our present-day designers have so successfully given, and what is more important, have catered for poorly-lined pockets.

I would like to give every credit to our pre-1920 designers ; they laid a fine foundation-stone. But our present designers deserve every credit for our craft being its present high standard.

Yours faithfully,

Luton. GEORGE ARCHER, A.M.Inst.B.E.

[Mr. Archer touches the spot !—ED. "M.E."]

"1831" Camshaft Turning Jig

DEAR SIR,—Mr. H. A. J. Lawrence, who constructed this jig soon after it was described in THE MODEL ENGINEER, and kindly offered to loan it free of charge to other readers, informs me that many of them have taken advantage of this offer, and requests are still being received. Owing to a change of address, however, he asks me to inform readers that letters should now be addressed to him at Lawrence & Sons, Willes Road, Leamington Spa. On behalf of readers, many thanks, Mr. Lawrence !

Yours faithfully,

Carshalton. EDGAR T. WESTBURY.

A Simple Three-cylinder Steam Engine

DEAR SIR,—I am very sorry to have to inform you that on reading the above article, a mistake on my part came to light ; not a drastic one, but I feel it should be mentioned and corrected.

The dimension given as 1 11/32 in (one and eleven thirty-secondths of an inch) on Fig. 3, Crankcase Frame, should be $1\frac{5}{16}$ in. (one and five-sixteenths of an inch).

I cannot think why I did not notice this slip before, for as soon as I looked at the Fig. in our journal I saw the discrepancy straight away.

Thanking you for making such a fine job of the publication, and with sincere apologies for the above.

Yours faithfully,

Twyford, Berks. P. H. MORRISON.

Review of "Model Diesels," 30/1/47, p. 152

DEAR SIR,—It may be pedantic, but surely what is intended in the first paragraph is "where *high power* per *unit weight* is required." Actually as phrased the sense is the exact opposite.

Yours faithfully,

Harrow. K. N. HARRIS.